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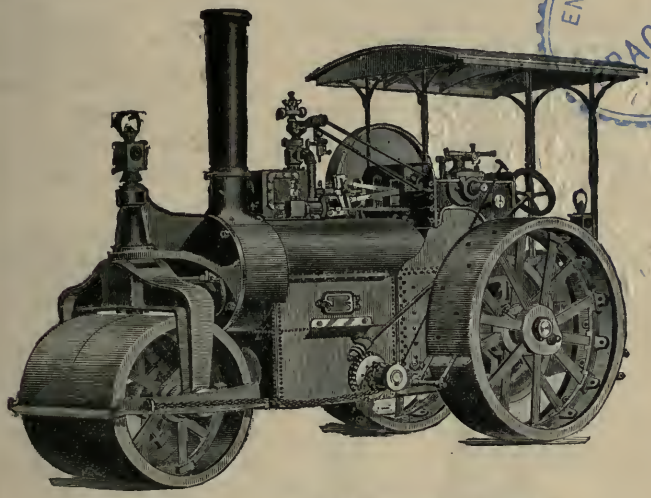

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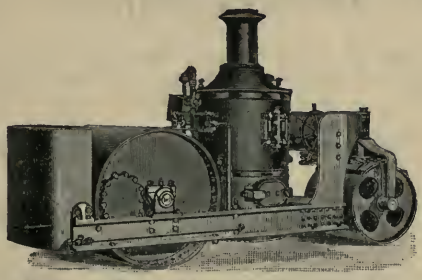

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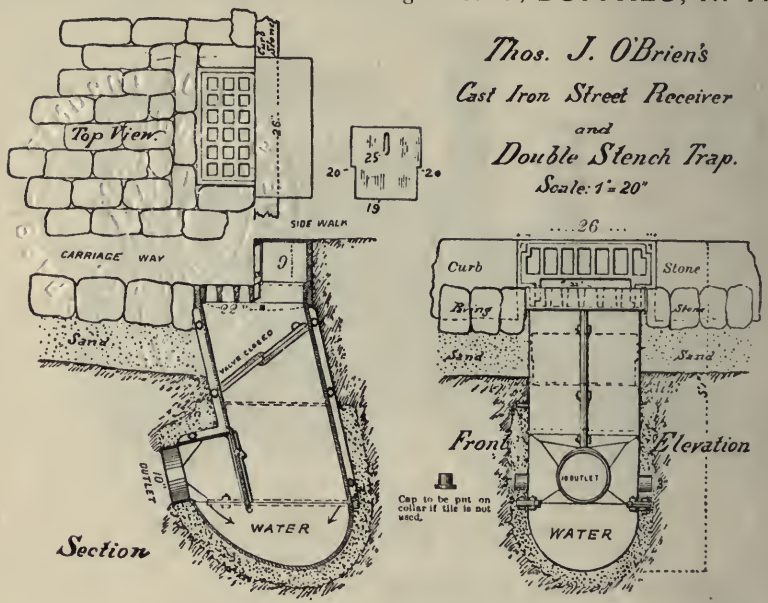

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CONTAINING THE

PROCEEDINGS OF THE MICHIGAN ENGINEERING SOCIETY FOR 1893

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Very Truly Yours
John W. Foster

MICHIGAN ENGINEERING SOCIETY.

ANNUAL CONVENTION, 1893.

AUTOBIOGRAPHICAL SKETCH OF JOHN H. FORSTER.

To Frank Hodgman, C. E., Secretary Michigan Engineering Society.

DEAR SIR:

While I am proud of the interest which you take in me as a comrade, I am free to confess that it is with great reluctance that I undertake to comply with your request, urgently made, to hand you some "field notes," in relation to my life-work as a civil engineer and surveyor. There has been nothing "brilliant" in my career, and all I can say for myself is, that I have always endeavored to discharge my duty honestly and faithfully, under trying as well as pleasant circumstances. The fraternal feeling existing among engineers, emboldens me to write.

Born early in this century, I feel that I have lived in an active, formative period and, not only so, but in the golden age of the republic; simple living, high endeavor, pioneer zeal, have characterized this nineteenth century. Battles for freedom have been fought and won, and civilization has advanced with gigantic strides. Civil engineers and surveyors have done their full share in this work. Their coadjutors, the mechanical engineers, are following close behind—perhaps to take the lead in future. The engineer has explored the continent and laid steel rails across waste places; surveyed vast domains in the face of hostile tribes, and marked out the homes of crowding

settlers; has opened lakes and rivers, far and near, to navigation, and has rendered available the treasures of the mines.

The engineer who has practiced his profession for forty or fifty years, has witnessed a progressiveness, an elevation, an exaltation in that profession, truly marvelous. He can point proudly to engineering achievements that would have astonished his forefathers. The marks of his genius are seen everywhere, between the Atlantic and Pacific; he has battered down the walls of exclusivness, and invaded Japan and China.

I was born at Erie, Pennsylvania, on the 24th day of May, 1822. My grandfather, Thomas Forster, was commissioned a Colonel by Washington, came from Harrisburg to Erie at the head of a colony of settlers, late in the last century. He surveyed and mapped the borough of Erie and owned a large portion of it. My maternal grandfather, Judge William Ball, was a large land holder and prominent citizen. He was a Scotchman. Colonel Thomas Forster's father came from Belfast, Ireland. His wife was a Montgomery. Judge Ball's wife was his sister. Thus the writer of this was of a Scotch-Irish descent. His father and mother were cousins. In the war of 1812, grandfather Forster was Colonel of Militia; he was foremost citizen in Erie and entertained Commodore Perry and other officers of the army and navy. Several of his daughters married officers who, afterwards, became distinguished in history. I write with pride, that both of my grandfathers had wives who loved their lords, each of whom bore fourteen children.

My father, Thomas Forster, first a merchant in Erie, later on became an engineer, and spent a large portion of his life in river and harbor improvements, under the United States Government.

The writer of this paper was educated at the Fredonia Academy and Livingston county high school, New York. Began engineering work as rodman, on the New York and Erie Railroad, in Cattaraugus county. After a time the company failed and the engineering department was disbanded, minus a whole season's pay. First unfortunate venture! For a time engineering enterprises were dormant. The writer,

having nothing better to do, to win bread, tried his hand at teaching a select school and reading Blackstone evenings, in the dull hamlet of Dunkirk, N. Y.

In 1843, catching the prevailing western fever, he migrates, thus anticipating Greeley's advice. Greeley was then a poor printer, and spent some of his time on the hills of Chautauqua. He sailed in a schooner from Dunkirk to Chicago, getting his first impression of the great chain of lakes, whose coast lines he was destined in the future to help survey. Landed after a two week's voyage in the village of Chicago, he encamped at night on the open prairie, in the tall grass, just across the river from the present Tremont House, then a two story white tavern, with the Conch brothers as landlords. Tried his unskilled hand at farming on the bank of Fox river, near Aurora; one year sufficed—on the farm. Returned to Dunkirk, N. Y., broken down financially and physically. The pestilential ague froze the marrow of his bones.

In 1844 the writer joined the lake survey as civil assistant. Our party, under the immediate command of Lieut. Gunnison of the corps of topographical engineers, spent most of the summer in measuring a base line for main triangulation on the north shore of the Straits of Mackinaw, a wilderness teeming with mosquitoes, black flies and *brulots*. It was near the present Mackinaw City. Late in the Fall ran the shore line to Presque Isle. Went into winter quarters at Buffalo. I will note here, that Lieut. Gunnison, a brilliant young officer, some years later, made a survey of Great Salt Lake, Utah, and published a book about the Mormons. Still later, while engaged in running an experimental line of railway from the Mississippi Valley to the Pacific, was massacred with his party by Mormons, disguised as Indians, near Sevier river, Utah. His book was doubtless the cause of his melancholy death. He was a dear friend of mine; it was by mere chance that I was not killed with him.

In 1845 the surveying parties began the survey of Green Bay, Wis. That section was almost an unbroken wilderness, in possession of Indians. Near the mouth of Fox river there was the little town of Astor and Fort Howard. There was a saw mill on the Menominee river. We did a large amount of

ENGINEERING SOCIETY SCHOOL OF

work. But before the close of the season the appropriation failed and the parties were disbanded forthwith. The writer made his way in a lumber wagon to the new town of Milwaukee, where he embarked on a steamer, and in due time arrived at Dunkirk.

Went to teaching and reading law once more.

In 1846 he was aroused from his quiet pursuits in the drowsy lake village by rumors of great discoveries of copper in the Lake Superior country, far off in the northwest. Lured by the prospect of great gain, and more by the certainty of an active life, the writer went to Detroit and joined an exploring party as a surveyor. In due time his party reached far-off Copper Harbor and Ft. Wilkins. He sailed across Lake Superior in a small schooner named the Swallow, lodging in the main hold, on pork barrels. He footed it across the portage at the Sault, where one now may see the great ship canal, with the largest locks in the world. He spent nearly two years in that land of frost and snow, working vigilantly as a surveyor, explorer, geologist and mine manager. He learnt much about woodcraft, the sweet uses of adversity, self reliance, and the value of a sufficiency of food and raiment. It was a hard life of toil, exposure and unmitigated hardship. Hours were long. As for fortune, the fickle jade ever eluded our grasp. In 1847 the copper speculation suffered a collapse. Everyone hastened to get out of the accursed country. The writer gladly retired with the rest.

In 1848 rejoined the Lake Survey, under my old commander, Gunnison, engaged on the survey of lake Erie, from mouth of Detroit river to Maumee bay. Happy again in this congenial work!

In 1849 I resigned from the lake survey, having obtained the appointment of first assistant engineer on the survey of the Mexican boundary line. I could not resist the spirit of adventure that lured me on to far distant, unknown lands. Our objective point was San Diego, California. The boundary commission rendezvoused at New Orleans. It sailed thence in a U. S. transport for Chagres, Isthmus of Panama. Arrived at Chagres after a delightful voyage across the Gulf of Mexico

and Caribbean sea, the large party of surveyors was divided and sent up the river in small dug-out canoes to Gorgona. The writer spent several days in a canoe, propelled by two fellows, nude men, with bamboo poles, subsisting upon the country. He could not speak a word of Spanish, nor could anybody he saw understand English. So he got along with "natural signs" very well. Crossed the mountains on foot, suffering terribly from heat; clothing was not necessary as it had been on Lake Superior!

We lay at Panama two months, our lives endangered by fever and cholera—waiting for transportation. By this time the gold discoveries in California were an assured fact, and the Isthmus and City of Panama were crowded with eager, dispairing adventurers, seeking passage up the Pacific to the golden shores, El Dorado. In the month of May, we embarked at Panama, arriving at San Diego early in June. We were six months *en route*.

Landing on Point Loma, the writer spent his first night in one of those famous "hide houses," mentioned by Dana. The 22000 stored hides impress one with their pungent odor and fleas. The next day we entered the adobe built, uninteresting pueblo of San Diego, so long the object of our search. The surrounding hills covered with grass, upon which great long-horned cattle grazed, and the noble bay of San Diego relieved the scene from utter flatness.

After some weeks waiting, the Mexican commission arrived. The officers of this commission were highly educated gentlemen; the rank and file, a mob of *greasers*, many of them taken from prison to serve as soldiers. There were plenty of women in the train.

Fifteen miles above San Diego, or the head of the Bay, our engineers encamped. The writer's first duty was to measure with his party, a marine league south of the southernmost point of the Bay as per treaty stipulation. The south end of the Marine league was to be the initial point of the boundary line, on the shore of the Pacific. This marine league was measured with much care, with a French metre bar and the writer had the pleasure of driving the stake at the point, on a

bold bluff, at whose base the Pacific ocean is forever rolling up its restless billows.

During the summer the writer assisted in making a topographical survey of San Diego Bay. He found drinking water scarce, but rattlesnakes too numerous. Curlews and quail were abundant.

In the month of October, 1849, he accompanied Col. Gray's party (Gray was surveyor under the Treaty,) across the coast mountains and interior desert to the Colorado and Gila rivers. We followed the assumed line of the Boundary, making a rough survey as we advanced. No white man had ever explored the route. Suffering and hardships were concomitant of the journey. In the great desert, north of the Gulf of California, we nearly perished from thirst. Our poor mules suffered terribly; there were earthquakes, and the heat on those sandy bottoms was terrific. The cool delicious waters of Lake Superior constantly returned to my memory with feverish longing. With swollen tongue and bleeding lips the cry for water was inarticulate, but very real. In the heat of the desert, Col. Gray left me to proceed alone with a small party, he returning to the Pacific with a starving party of U. S. officials—"carpet bag" custom house. I traveled night and day—the stars were my guide over the shifting sands. The Colorado Indians were hostile, but we reached the mouth of the Gila without loss of scalps. A troop of U. S. dragoons was stationed there, and Lieut. Whipple, corps topographical engineers, had an astronomical camp. *He* fed me; after which I threw myself on the ground and slept fourteen hours without turning over. I made a survey of the junction of the Gila with Colorado, by triangulation; there were no boats, so Dr. Perry, of the army, and botanist, volunteered to set up my flags at the mouth of the Gila. He swam the wide, swift-flowing, yellow Colorado, set up the flags, and returned safely. At this time the thermometer stood 110° in the shade, and a bath was agreeable. Finishing the survey at 10 p. m., we mounted our mules and set out for the Pacific. Passed hundreds of emigrants, pushing forward through the sands, for the distant gold fields. Suffering, destitution, ruin and death marked the long

line of our route. We, ourselves, suffered greatly from want of food and water. But, finally we reached San Diego without loss of man or beast, but ragged as savages and as ravenous.

The commission spent the winter, "rainy season," in the mud hovels of San Diego, subsisting upon hard-tack, coffee and "coone," bull meat. The commissioner deserted us and went to Monterey and was elected U. S. Senator. Col. Fremont, the new commissioner, under Gen. Taylor's administration, we never saw. He too, had the Senatorial bee in his bonnet. The outcome of the whole matter was this: Abandoned by superior officers, without food or pay, the subordinates left to themselves, scattered far and wide.

The writer, having no choice, went to Alta, California, and remained in that section until 1855. He by turns was a day laborer, a farmer, a cow-boy, a swine-herder, a gold miner, a postmaster, a tramp, a Probate Judge, (Public Administrator,) a Judge of County Sessions and escaped being State Senator by coming back to the "States." His patrons and friends, most of them, having been shot in rows, and liking a whole skin better than a possibly eternal resting place in the land of the setting sun, the writer "vamosed."

In May, 1855, by a rapid transition, the writer rejoined the Lake Survey at Detroit. He came home via the Nicaragua route, over lines near the proposed Nicaragua canal. A canal at that point of the Isthmus, seemed to be of no difficult attainment.

The Lake Survey was now under the command of Capt. Meade, afterwards General Meade. The month of June found me with Mr. Wm. H. Hearding, C. E., making a topographical survey of Beaver Island, lake Michigan, under the hostile eye of King Strang and his Mormon disciples. Strang was a man of strong character and considerable ability. Later on he was shot by one of his own people.

1857 I quitted the Lake Survey for the River and Harbor Improvement department—a promotion. Capt. Whipple, U. S. Eng. was chief officer. I had known him as astronomer of the Mexican Boundary Line survey. I was placed in charge of improvements in St. Mary's river, with Capt. Whipple, later

on a general in the Union army, killed by a sharp-shooter at Chancellorville. He had offered me the position of assistant adjutant General in his division, which was declined. He was a dear friend.

I remained two years on St. Mary's river, first completing a canal by dredging through the flats of Lake George, and dredging west channel of Neebish rapids, when I resigned from the Government service, *finally*, to take charge of private work at Portage lake, lake Superior, another promotion! Built a breakwater at mouth of Portage river, during the winter of 1859, cutting holes in the ice to sink cribs in. In the fall of 1858, dredged a channel 1200 feet long, through a tamarack swamp, into the river, and made a topographical and hydrographic survey of the river, a crooked stream five miles long. The season being late, I could only lay out the work and finish soundings before the ice closed the river. After the ice became solid, and the marshes lining the river frozen, I managed to do all instrumental and sketching work admirably. Winter is the time to *do* marshes. But handling my theodolite with the thermometer 10° to 20° below zero was rather *hot* work. Without gloves, the brass screws would *glue* ones fingers instanter. Altogether it was nipping, lively work, but very satisfactory at the end. A large map of the river was made at my leisure, in my parlor at Houghton, my wife and baby being my company. Strange! I had forgotten to tell you of the most important event in my life, so far as I am personally concerned; the happiest event; and the luckiest. Namely, on October 22, 1855, I was married to Miss Martha Mullett, youngest daughter of John Mullett, the distinguished land surveyor and engineer of Detroit. You see, as I am a surveyor, I am fortified on all sides, for, you will notice that my grandfather and father were of the same ilk.

In the fall of 1860, I was appointed chief manager (agent) of the Pewabic and Franklin mines, (copper,) still acting as engineer of the Portage River Improvement Company, and also as director in that company, for several years thereafter. Portage river was opened by the mining company of Portage lake, without assistance from the general government. I

piloted the first steam boat up to the mines. In the course of five years, I finished mine-plants, mills, docks, roads, and tram-roads, for the Pewabic and Franklin mines, and brought both of those mines to a dividend paying basis.

In 1864, the writer was elected to the State Senate—the only Senator from that vast territory, known as the Upper Peninsula. Political office not suiting the habits and tastes of an old surveyor, subsequent honor of the kind, though tendered, was respectfully declined.

Overwork and affliction—the loss of my sweet daughter, and only child, compelled me to resign from the charge of the mines.

My wife and I spent a long vacation in traveling.

But idleness did not bring *peace*. In 1866, I accepted the management of some copper mines, upon which work had been suspended for some time. Built a stamp mill, docks, etc. But the mines were not profitable.

In 1868, I visited southern Nevada, to examine and report upon certain silver mines. I spent the winter in the mountains, suffering much from cold and fearing the Indians, then on the war-path on several lines. Reached San Francisco with a whole scalp in March. Returned to New York by steamer, via the Isthmus of Panama, sweltering under tropical heat. About the middle of May, the steamer I was on, a lake-craft, was stuck fast in the ice, off Marquette, Mich.

Governor H. P. Baldwin, intercepted me in Detroit, and commissioned me as engineer of the State work, namely, "The Portage Lake and Lake Superior Ship Canal." Remained in charge of that work during a period of five years or more, serving part of the time under Gov. J. J. Bagley, seeing its completion. This canal cost about $3.000,000. In the year 1874, much broken in health, the result doubtless of early privations, and with a crushed leg, so imperfectly mended as to render tramping and standing by a transit a grievous labor, the writer, unwillingly, but gracefully as possible, retired to his farm, near Lansing, in Ingham county, Michigan.

The graceful part came from the fact, that he could retire with comfort. Wonderful to relate; for one of his profession,

after so many buffetings of fortune, he had accumulated enough of the "dust," as we used to say in the gold mines some forty years ago, to keep the wolf from the door during a reasonable term of life. On Springbrook farm, surrounded by his gentle Jersey's, his fleecy Shropshires, his pigs and chickens, he is reasonably happy, thank you, "the world forgetting, and by the world forgot."

But like an old man who has passed the mile stone marked 70 years, in his quiet retreat he "delights to fight his battles over again."

In his ample library, he can commune at will with the good and wise of all times, but his heart often yearns for his old comrades who have cast off the veil of the flesh, and are hidden from his mortal eyes.

The writer must fain confess, that the path set for him to travel through the wilderness of life, has not been free from danger and privations of an uncommon kind.

So it is with unfeigned gratitude, that he acknowledges the goodness of his Heavenly Father in rescuing him from so many perils, and he looks to a merciful Savior for ultimate pardon and peace.

"So long Thy power has blest me,
Sure it still will lead me on
O'er moor and fen, o'er crag and torrent,
Till the night is gone,
And with the morn those angel faces smile,
Which I have loved long since, and lost awhile."

—From Lead Kindly Light, No. 512, Church Hymnal.

Very sincerely your friend,

JOHN HARRIS FORSTER.

November, A. D. 1892.

PAPERS AND DISCUSSIONS,

At the annual convention, held in the council rooms at the city of Lansing, Jan. 17, 18 and 19, 1893.

ADDRESS OF PRESIDENT MUENSCHER.

Gentlemen of the Michigan Engineering Society:

In compliance with the custom which requires your president when entering upon the discharge of his duties, to say something bearing upon the interests of this society, I beg leave to touch briefly upon a single point. It is the duty which the members of the society owe it in the way of contributions to its proceedings. I am aware that this subject has been alluded to before, and more than once, but it has been only within the last few weeks that I have begun to appreciate the labors and disappointments which have been the lot of our worthy Secretary for so many years, for I never knew till then how negligent most of us have been.

Let me call your attention to a few facts. Our last Annual showed a membership of 152. Of these but fifty, or less than one-third of the members had, as far as I can learn, ever contributed a written paper to our proceedings. Two others have contributed valuable oral discussions. The remaining 100, or *two-thirds of the entire number have never contributed a single line*, except perhaps to ask an occasional question. Of the fifty who have contributed at all, twenty-six, or more than one-half, have furnished but one paper each. Ten of the remainder have furnished but two papers each, leaving but fourteen, or one eleventh of the membership to furnish more than one-half of the entire proceedings of the society, and out of these fourteen, it is an actual fact that only three gentlemen have furnished more than twenty per cent. of the entire amount.

The mere statement of these facts ought to make some of us pause and reflect whether we have done our duty to a society which gives us so much in return for the trifling fees

which we pay, or rather whether it has not been ungenerous for us to be content to enjoy the benefit of other men's labors, while neglecting to contribute anything ourselves to the common fund.

Much of this neglect is due, no doubt, to want of leisure, but more, I am inclined to think, to the fear that we think we cannot say anything that is new; that what is interesting to us is probably perfectly familiar to all the rest of the society, and that if we write about it, they will look upon our effort as threshing out old straw, or cracking old chestnuts. Just here is where we are liable to make a great mistake. If all of us should wait until we could announce some startling discovery, or develope some new principle, there would be but few papers written. It is only once in an age that a Newton, a Laplace or a Franklin flashes upon the world to discover some great law of nature, or found a new science, but in the meantime thousands of humbler workers, like the minute builders of the coral reefs, have been adding their little mites to the growing mass of human knowledge, which has now become so vast that no one mind can grasp more than a small fraction of it. It is these small contributions that have done the work, each one perhaps serving as the foundation on which another is laid. The steel of one man's thought strikes fire from the flint of another man's brains. So long as they are kept apart they are but cold lifeless flint and steel; bring them together and they may explode a mine, or start a Chicago fire. Human knowledge is still in its infancy and there is still plenty of work for us all to do; new facts to discover; new fields to explore, or old ones to replow. And no field is so vast as the one into which we have been thrown.

Practical engineering science has been largely the growth of the last fifty years. At the beginning of that period, but little was known of the principles which control the construction of city sewerage, the purification of water, the calculation of the strains in bridges, or the application of electricity as a motive force. These branches of the science have all been built up since that time, not by any one great mind, but by the combined efforts of hundreds of laborers,

and still there is abundant room for investigation. To be convinced of the truth of this statement we need only compare the scanty pages of Brunell, and Dempsey, and Hughes, which were the sole dependence of some of us in our younger days, with the great works of Latham and Adams, and Waring, and Pierson, of Fanning and Humber; the first editions of Haupt and Whipple with the exhaustive treatises of Greene, and Burr, and Dubois, and Waddell, or even the first thousand of Trautwine's Pocket Book, with the last.

To show what important consequences may flow from an apparently trifling circumstance, let us take a single illustration from the history of this progress. Less than fifty years ago a bridge builder noticed that the chords of a bridge that had settled were bent more in proportion near the abutments than in the center. He mentioned the fact to one of the most prominent engineers of the day, and enquired what the cause was. The engineer could not reply; he had never observed the phenomenon, but the seemingly simple question started one of the trains of thought and investigation, which little by little, have led up to the present elegant theory of bridge strains.

Our recent field books are not the work of one brain, but rather collections of the happy thoughts and expedients of dozens of locating engineers in solving knotty problems, which had presented themselves perhaps for the first time in their field practice. And the field is by no means exhausted. We have just entered the outskirts. There is probably not a single member of this society who does not see, or hear or do something in the course of each year that is worth telling, and what the society wants, and what it has its annual meetings for, is that he shall tell it.

The great engineering societies of this country and of Europe are spending days and weeks in discussing matters that seemed to be settled years ago, trying new experiments, modifying old rules, measuring the effect of new facts, or the value of new theories, correcting past errors, and even quarreling about whether we should use the square root or the cube root of x in the formula for some insolvable piece of empiricism. And why should not we, in our less pretentious sphere do the same thing.

We, in Michigan, have a wide and varied field of labor of our own. Our lumber camps and saw mills, our iron and copper mines, and our quarries of stone and gypsum, our magnificent river and harbor and coast improvements, might furnish abundant material for papers, which would not only be interesting to us, but valuable outside the State. Other societies are gleaning in similar fields elsewhere, while we are neglecting our own. Why cannot some member from the northern counties take us into a virgin pine forest, and show us how to select camping grounds, to erect and furnish the buildings, to lay out the roads and organize the lumbering force; what tools are used, how the cutting and skidding and loading is done, how the roll-ways are broken, and the logs run to the mills, what each man ought to do, his wages and the cost of his work. Why could not another describe the modern machinery and processes by which the logs are taken from the boom and manufactured into lumber, with the score of little expedients which may make the difference between success and failure. No doubt, many of us have spent hours watching with ever fresh interest the isolated details of these industries, and could listen with equal interest to a connected and intelligent account from any one who was familiar with the whole subject.

Why cannot some one else explain how the wells are sunk which draw from the deep caverns of the earth the vast treasures of Michigan brine; the machinery employed, the difficulties met with, and how they are overcome; how the wells are kept in working order, and the brine which they produce converted into salt?

Why cannot those who have had experience in our river and harbor improvements, tell us how the works are constructed, the principles which control their design, and the difficulties to be met and overcome? Mr. Ripley has given us some excursions into this field, but we all have an appetite for much more. Our Northern Peninsula mining regions might furnish a feast of whose richness we may judge by the choice bits which we have had from Mr. Forster. The plaster mills of Grand Rapids; the stone quarries of Ionia, and many another

local industry might furnish the material for a valuable paper. All these things become so perfectly familiar to those who see them every day, that they unconsciously acquire the feeling that everyone else must be just as familiar with them as themselves, and yet I venture to say, that there are not five members of this society who could not learn much that would be new and interesting to them on any of these subjects. I might even go further and assert that an enterprising, wide awake newspaper reporter would find out in a few hours investigation, a good many things that none of us have thought of, to say nothing of numerous other things that are *not so*.

The economical geology and mineralogy and botany of Michigan furnish wide and almost fresh fields for investigation and discovery. How many of us could accurately describe the geological structure and history of our own counties, or all the varieties of timber to be found on their soil, their physical characteristics or the most profitable uses to which they can be applied.

There is still another extensive field in which some of our members might find material. Our city engineers might give us at each meeting an account of their past year's work, the experiments they may have been trying in new materials or methods for paving, or sewerage, or water supply, or perhaps the plan and treatment of a new public park. Several of our cities have been recently laying asphalt pavements. Who can tell us how they are succeeding under the extremes of heat and cold of our Michigan climate, or whether it has been found necessary to change the usual specifications to meet these conditions? Our railroad engineers might furnish us each year with maps of the lines they have constructed or surveyed, with the elevations marked on them, and the character of the soil and timber, and thus with little labor, add something each year to our knowledge of the topography and natural features of our State. Indeed, so many things occur to my mind which each one of us might have done that I am ashamed to further expose my own negligence.

Let us all resolve to do our part next year, even if it be but

a single page—without compelling our long-suffering secretary to ask us a second time.

In conclusion, gentlemen, permit me to express my sincere thanks for the unexpected honor which you have done me by electing me your president, and the hope that our relations may be mutually pleasant and improving.

E. W. Muenscher.

Mr. Appleton: There are so many suggestions in our President's message that go right straight home, that I would like to see it referred to some committee who would make some report on it. I move the appointment of a committee to take into consideration the President's opening address.

Motion being supported and carried, Messrs. Appleton, Granville and Skeels were appointed to act on the committee.

The committee having given the matter due consideration, made the following report:

To the President and members of the Michigan Engineering Society.

Gentlemen: Your committee appointed to consider the President's address, has very carefully considered the matter of preparing papers by members, to be read at the annual convention. We find that many members do very little towards providing matter for the good of the Society, in return for the valuable information they receive in the annual reports of this and other similar societies. Your committee admit to being somewhat perplexed to provide a remedy for this direliction of some of its members. We believe that in many cases this results from a feeling of diffidence which prompts many to think they have nothing new to say, or of interest to all members of the society; this mistaken notion keeps many pens idle, which might give many bright and valuable hints to the profession. Others are always ready and willing, and these are the contributors who fill our annual reports.

We dislike to heap more work on our secretary, but as the secretary and president are the best acquainted, and con-

sequently are the best qualified to carry out the idea of making a personal request of any member to prepare a paper for the use of the society, on any subject desired, and which request will tend to spur on modest members to give us their knowledge and make all partakers in their skill and ability, we recommend the adoption of the following:

Resolved, That when any information of any subject is thought to be for the interest of this society, the president or secretary, or both, are requested to ask any member of this society to prepare a paper, giving his knowledge or ideas on the said subject, to be read at the next succeeding annual convention, and it is the duty of every member to comply with such request.

Nothing in this resolution is to be construed to discourage voluntary papers by members, on such subjects as they think may be of interest.

Respectfully submitted,

WM. APPLETON,
JOHN GRANVILLE, } *Committee.*
D. SKEELS.

Report adopted.

Motion for the appointment of a committe on questions of practice being put, supported and carried, Mr. Hodgman, Mr. Strong and Mr. Rogers were appointed to act on the committee.

THE PRESIDENT: What is the pleasure of the meeting; are there any committees ready to report at this time?

MR. HODGMAN: I think there is only one standing committee that was to be called upon for a report now, and that is the committee on the World's Fair business. I was elected last winter as a member of the committee, to take into consideration the question of accommodations for the Michigan Engineering Society at Chicago, during the World's Fair. The thought was that the Civil Engineering Societies of the country were uniting together for the purpose of providing entertainment for all engineers who came from abroad—to have a special place of meeting, and the thought was that we might take part in such a movement as that. On investigation

I found that all engineers who wished to avail themselves of the privileges of this society, could do so by paying $5.00 a piece. My feeling was, that the Michigan Engineers, as a Society, wished to have nothing to do with it.

We have organized a local society in Kalamazoo—two members of this society are also members of that, Mr. Wm. J. Kirby and myself. They have obtained a good lot and are going to put up a building for the accommodation of the Kalamazoo people and those of the Michigan Engineering Society who wish to make arrangements for a home there. The arrangement is to furnish rooms suitable for two persons. The rooms will be rented at $1.00 a day. Any person wishing rooms can apply to the secretary of the society at Kalamazoo, stating at what time they want rooms, and have the rooms reserved for them. Nothing to pay until they have the rooms. It is two and a half miles from Jackson Park, and in connection with several roads, and we are planning for about sixty rooms.

MR. APPLETON: Is it for Kalamazoo people, irrespective of Engineers or anyone else, and are we allowed to become beneficiaries of this institution?

MR. HODGMAN: We propose, if the Michigan Engineering Society want accommodations there, to make arrangements to furnish them, only we would like to know before putting up the buildings, whether the society propose to avail themselves of it.

SOUTHERN CALIFORNIA AND ONE OF ITS WATER SYSTEMS.

PAPER BY A. L. REED.

The arid lands of the western portion of the United States and their reclamation is a question in which many are of late years becoming interested. As long as the fertile prairies of Illinois, Iowa, Kansas and kindred locations furnished such desirable fields for agriculture and gave such quick and oft-times easy and large returns for labor and investment, the development of the arid portion was little thought of by the general public, and only to the few was their real value known; but in the last few years the capabilities of these soils under skilled treatment, coupled with the salubrity of the climate in which some of them were located, and the almost fabulous returns they have yielded to their owners, has made the question of their development of special interest to many.

In character, as well as location, these arid lands vary greatly, the soil being all the way from a light sand to the heaviest clay and adobe, and the elevation from considerably below the sea level to several thousands of feet above. On most of these lands the annual rainfall is insufficient, and its precipitation confined to so short a period that without being watered by artificial means, crops cannot be produced at all, or only to a very limited extent and in favorable seasons.

The scope of an article of this kind is too limited to go into extensive generalizations, and will perhaps serve its purpose as well by confining it in general to the semi-arid lands of the coast region of Southern California, and especially to a single water system as therein developed; and to such limits will this paper be confined.

Lying westward from the Sierre Madre Mountains, and between their base and the Pacific Ocean, are the once semi-arid valleys and mesa lands of Southern California. These valleys differ somewhat in their conformation; the upper

valleys being in nearly all cases separate and distinct from the lower, the separation being made by a range, or ranges of hills. The upper valleys assume in many cases the form of more or less well defined basins, hollowed out, perhaps by glacial actions, and afterwards somewhat filled in with drift, and the wash and deposits from the stream; the lower valleys between the hills and the ocean, assuming the form of a broad sloping plain with comparatively smooth surface.

The streams as they issue from the mountains in narrow, and oft-times precipitous canyons carry, especially in times of flood, immense quantities of boulders, cobble stones, gravel, sand and silt which is deposited in the order named along their courses. Thus by annual deposits, the streams raise their channels above the adjacent lands and in time of flood often break away and seek new channels, leaving where the former channel was, only a mass of boulders, cobble stones and gravel; and oft-times impinging against a higher point of mesa land, cut it away, and with the sand and silt already in the water, carry it down to the lower valley to be deposited over large areas, making a very rich covering, but at the same time making the locality very uncertain in its character; for this season you may be on one side of the stream, the next on the other, and still the next in mid-stream.

The dip of these basins is, uniformly, from the mountains to the hills, and from each rise that separates the basins, toward the main stream and toward the point of its break through the hills into the lower valley. The lower valleys have numerous small streams breaking from the mountains, but they all find their way, when their volume is sufficient, into the main streams of the upper valleys, so that only main streams cross the lower plains, with perhaps the exceptions of the excess flood water from short canyons in the hills which, however, are soon dry.

A word of explanation just here, to those who are unfamiliar with the streams of the arid regions: They run, many of them, during the greater part of the season, as the expression is, "bottom side up," the sand on the surface and the water below, so that where in times of flood are wide, but shallow streams,

for the greater portion of the year is a small rivulet, or perhaps a broad expanse of boulders, gravel and sand. Many streams that emerge from the mountain canyons, quite large in volume, within a few miles have entirely disappeared and no water will be seen for miles, when they will gradually appear again in springs and form quite a stream, flow a few miles and again disappear.

The lands of the upper valley vary very much, running from a fine sedimentary sand to heavy clay, adobe, gravel, and in places almost entirely disintegrated granite. The lower valleys vary nearly as much, except there is an entire absence of the boulders and granite sand, and more of the fine alluvial deposits and some peat land near the coast in certain localities. Such in brief is the character of the streams, valleys and soils of the semi-arid region of Southern California.

Here, but a few years ago, and still to some extent, large herds of cattle and sheep found winter pasture, and the wolf and coyote roamed at will. Now the valleys and mesas are dotted with cities and villages, and covered with fields of waving grains, orchards of oranges, lemons, limes, olives and all kinds of delicious fruits, groves of stately eucalyptus, graceful pepper trees, with here and there palms, magnolios, and semi-tropical trees of many kinds. What has made the change? Simply the intelligent use of water. Where this water is secured, how conducted, how used, let us examine.

The earliest irrigation works were of the rudest sort, if indeed they could be called works at all. A settler, or a community of them, select some of the smooth, low lying lands adjacent to the stream and, going a sufficient distance above, dug a ditch having less fall than,—and gradually working back from—the stream, so as to bring it to the back or high side of his land, from which point it was distributed over it in rude ditches or plow furrows, and handled in a very primitive manner; the ditch being filled with water diverted from the main stream by a rude wing dam of willow bush and stakes which were washed away very often, and as often renewed, until the season's needs were supplied.

Many of the older water systems are still little better than

the one just described, although most of them have, at this time, some more or less modern appliances and methods.

However as the settlements increased, and the higher lands were occupied, and found to be in many respects more desirable than the lower ones, they were obliged to seek water from higher sources, carry it longer distances and by more skillful means. Finally, in the lower valleys the limit of the elevation was reached. Fine land lay above the highest water —high up the river there was no water, at least in sight— and a supply must in some way be found and perhaps conducted a long distance. To some of these more extensive systems let us briefly turn our attention. First, as to the sources of supply:

The lower valleys, in the primitive method just mentioned, soon appropriate all the lower flow of the streams; the upper valleys go to the mouth of the canyon and there divert the entire flow for their especial service, but this is not sufficient. The great flood stream of the rainy season must be secured, and held for distribution. Suitable locations are located, or settled in the mountains, dams built, and an immense quantity stored and distributed when needed. Notable examples of this method are the "Bear Valley," and "Sweetwater" dams, of which enterprises and the brains that conceived and the hands that executed, too much in praise can scarcely be said.

Tunneling into the hills and mountains, tapping springs and the underflow of streams, is another method that has, in some places, been very successful. Another, which is now receiving much attention, and which is being eminently successful in many places, is the development of the deeper subterranean water by means of artesian wells.

There has, in the region under consideration, been developed from a single well a flow exceeding two cubic feet per second.

Along the lower margin of the lower valleys these wells are very numerous, and in few cases has there been a failure to secure a flow; but most of the wells are of inconsiderable volume and only serve to irrigate a small area in their immediate vicinity; hence we shall give them only a passing notice.

In the upper valleys, however, there appears a different order of things. The different basins heretofore mentioned appear to be as entirely distinct in the subterranean, as in their surface waters and to have no connection, each with the other, and even different portions of the same surface basins appear to have their under surface waters entirely separate.

The "San Bernardino Basin," so called from the county and city of that name, has been the most developed, and has, and is, yielding large quantities of water. The San Bernardino valley lies almost wholly in the county of San Bernardino and is abruptly hemmed in on the north by the rugged Sierra Madre Mountains, while close on the east, tower the lofty peaks of Mount San Bernardino and Grayback, and on the south, by a range of hills extending from the mountain base to the hills of the Coast Range. Entering it from the northwest, in the Cajon (Cahoon) pass, from the extreme eastern end is the Santa Ana river; from the southeast comes in the San Gorgonio Pass, and between these, various smaller streams, some perennial and many only showing on the surface a portion of the year.

This basin has an area of about one hundred square miles, of which the artesian portion, as thus far developed, is something like twenty square miles. The artesian development of the Gage Canal system is in this basin, and the average of the first twenty-nine wells was thirty-three miners' inches per well. A legal miners inch in California is one fiftieth of one cubic foot per second.

The city of San Bernardino obtains its supply from the same basin, and there are various other systems of which there is no time to speak.

The development to which I shall briefly call your attention, is in Los Angeles county, and in what may be called the "El Monte Basin," of the upper San Gabriel valley, and through which, during the wet season, flows the San Gabriel river, which drains a mountain area of about two hundred and twenty square miles of rough rocky surface. The entire summer flow of this river is diverted at the mouth of the canyon, and supplies quite an extensive region contiguous thereto. There is below this division, for ten miles or more,

no surface flow; then, in the El Monte Basin, the water again gradually appears at the surface, and by the time the gap in the Coast Range of hills is reached it has become, from the springs and the inflow of some spring brooks, a considerable stream. All these waters are again diverted and used in the lower valley within a few miles of the Pass and the lower portion of the bed is again entirely dry.

The El Monte Basin is located in the middle of the upper San Gabriel valley, and the river at the point in question, just begins to show upon the surface.

In 1888, some Michigan gentlemen, who owned a tract of land in the lower valley, close against the foot-hills, and above the irrigation water of the valley, having failed to secure water by tunneling into the hills, determined to make the experiment of developing water in the Basin above referred to; and to that end, made a trial cutting, and sunk a test well, in which cutting they secured a generous flow from the gravel strata immediately below the surface and from the well a flow of about one fifth of a cubic foot per second.

Nothing further was done until 1890, when the writer was called upon to go and make a development cutting, and sink a series of wells, and if successful in securing water in sufficient quantities, to construct a main and distributing system, and a complete pumping system for the lands above the gravity flow. This system I shall briefly describe.

The fall of the river wash or bed through the El Monte Basin is from twenty to thirty feet per mile, and is simply a broad expanse of dry sand and gravel. On either side of the channel are benches a few feet higher, of similar material. Commencing at the lower end of a strip of land owned by these parties, which lies alongside and parallel with the wash, a Marion Steam Shovel was set at work. The cutting began at about six feet depth and gradually cutting deeper, running on a grade of about four feet per mile. This work was kept going with varying progress for about ninety days, and had cut into the sand, gravel and quicksand a channel more than one half a mile long, and from six to sixteen feet deep, and from twenty to sixty feet wide.

The material was very difficult to handle, or rather an excessive amount was necessarily handled, as from its nature, it caved and slid in very badly at times. In the bottom of this cutting was placed in sections, and secured, a wooden flume, four by six inside measurements, with cross sills of two by ten; longitudinal sills of two by ten; side posts and caps of four by four; and two inch plank sides; all of strong Oregon pine, and well spiked.

The excavation was made somewhat below grade line, and after the flume was secured in place, this bottom space was filled with coarse gravel to serve as a check upon the sand rising in the bottom, and, after two years of service, very little sand had come through the gravel bottom. The back filling along the sides was also made of coarse material, to allow as free percolation as possible from the quicksand and water bearing strata through which the cutting was made. From the cutting a flow of one hundred and fifty inches, or thereabouts, was secured.

During the progress of the cutting and fluming, work was prosecuted on artesian wells, and twelve were put down to depths varying from eighty to two hundred feet. Each one gave a greater or less flow, varying from one tenth to over one half of one cubic foot per second.

One remarkable thing about the wells, is the exceeding irregularity of the strata through which the borings pass, although in some cases they are within one hundred and fifty feet of each other. Although invariably a stratum of impervious clay was passed before a flow was secured, in some cases the clay was only a foot or less in thickness and in some cases twenty feet thick.

The method of sinking the wells was the ordinary sand pump, run by horse power, and was very rapidly and economically performed, the twelve wells complete costing less than two hundred dollars each, and being cased the entire depth with number sixteen double casing.

Having within ninety days developed nearly four hundred inches of water, we were warranted in proceeding with our work of constructing our main conduit and in order to do

this, must determine its grade, size, capacity, manner of construction, etc.

It was finally determined to make the conduit to carry fifteen hundred miner inches, or thirty cubic feet per second, on a grade of one in four thousand, with Portland cement, concrete sides, and bottom of the following dimensions. Neat bottom width, four feet, width 8″ below top, and at top six feet, depth 3′ 4″ figuring on a neat depth of water of three feet. The flumes, of which there are several aggregating over six thousand feet in length, are 4′ 6½″ wide, 3′ 4″ deep, and will be described in detail later.

Beginning at the lower end of the developement cut, the line of conduit runs a few hundred feet along the lower bench of the valley and strikes the foot of the bluff, and following along the line of, and gradually creeping up to a mile below, it is upon the mesa, upon the bluff; from this point the line strikes directly across the main valley of the river, by a flume and trestle, four thousand three hundred feet in length, to the mesa on the opposite side, thence across one quarter of a mile to the Puente Creek valley, which is crossed by a flume and trestle nine hundred feet long, and an extreme height of forty feet; the line then strikes the main range of the Puente hills, along whose steep sides and sloping base it follows for several miles till it crosses Sycamore Canyon on to the smooth sloping mesa, where it follows around the grade line in easy curves through the village of Whittier, to the East Whittier tract, which land it is the primary purpose of the enterprise to supply.

Along the hillside, in many places, too steep to more than obtain a foothold, the benching in was begun by hand, until sufficient width was secured to work a single horse or mule, when the material, when practicable, was plowed and pushed off by a side-hill scraper or "vee," until the grade line was reached, and the bench was eight feet wide and ready for the excavation; for the entire work has been made in excavation to avoid settling and washing away of embankments.

The first section of the work was put in December, 1890, and January, 1891. The excavation being in a fine soft sand,

the concrete was made of one part of Portland cement to ten of sand and gravel, just as they were taken from the river wash, very clean and good.

The specifications were one cement, three sand, nine gravel; but suitable material being found as stated, without screening, it was used one to ten, and made a very satisfactory piece of work. The larger portion, however, was made one to eight, the main body of the sides and bottom being 2½″ thick, the corners being reinforced and the upper 8″ being vertical on the inside, the outside having a uniform slope of one in three.

It may, perhaps, be not uninteresting to briefly describe the method employed in the work.

The excavation was first made to a templet the exact size of the outside. It was excavated by hand as it was found inexpedient to use teams, except to plow and loosen the material, and then strong horses were used tandem. The men became very expert in making the excavation the exact dimensions required, as, if too small the inspector objected, and if too large it took more concrete than the contractors liked.

Light skeleton forms were made of two by three pine, connected by one by four side strips, each being twenty feet long, and well braced. These forms were light enough to be easily handled by two men. They were placed in the excavation, neatly adjusted to position, and held firmly in place by iron pins driven in the bottom. One inch by twelve boards were used for the sides, put in one at a time, and the space behind them partially filled with fresh concrete, which was thoroughly rammed and packed; each layer or course being not to exceed 6″ in height; after ramming, the sides were carried up thus the width of 3–12″ boards, then an 8″ strip placed vertically completed the form. Behind this 8″ strip were placed thin wedges that were easily withdrawn, when ready, and the 8″ strip loosened and lifted out when the entire frame work was easily taken out, and placed on the bank, leaving the lagging to be taken out one board at a time. The alignment in places being very crooked it was found difficult to adjust the ends of the frames and lagging, and to obviate this strips of sheet

iron was used at each joint, which fitting behind the ends of the adjacent lagging boards covered the joint and greatly facilitated the work, these joints being the thickness of the iron —thinner than the remainder of the wall—were plastered over as soon as the forms were taken out.

The concrete was mixed at intervals on platforms of boards and shoveled directly on to a low hopper car running on a portable wooden track of two by four, laid in sections on the upper cross pieces of the frames. In this manner the mixing places could be made three to four hundred or more feet apart and the material delivered at the exact place it was to be used, and with a completely organized crew it was possible, and we did many times, put in as high as seven hundred lineal feet per day of completed concrete work.

As soon as the frames were removed which was as soon as the material had sufficiently set, a man, with fine mortar and trowel, followed, smoothing up the rough places, filled where necessary and trimmed up the work. Following him came the bottoming force who spread the concrete evenly over the bottom to the necessary thickness and thoroughly rolled it with a heavy hand roller filling the corners flush and tamping by hand. As soon as the walls were sufficiently set, they were given a heavy coating of neat cement wash of the consistency of thick cream, applied with a heavy white-wash brush, which gave the wall a good finish, filled the pores and made it water tight.

The concrete conduit is covered the entire length with pine or red wood plank from two to four inches thick, spiked to three two by three longitudinal strips with 20d spike. The outside strips are pressed firmly against the vertical face of the concrete and make the whole very firm and solid. The planks except through the village and in special places, are not covered with earth and are cleaned of all dirt and rubbish each season. At intervals of two thousand feet or at each 6″ fall, bulk-heads are placed, or rather slotted recesses are made with concrete so that flash plank can be slipped in them, making a reservoir of the entire conduit if necessary. At intervals not exceeding one thousand feet, are placed man-

holes and ventilators in the covering made two feet square at one end, nothing at the other; the large end screened by a removable screen of six by six, mesh number 22, galvanized wire; these are secured in place by a common lag screw whose head goes into a countersunk casting so that it can only be reached and turned by a special socket wrench.

At convenient points, when necessary, outlet valves are placed solidly in the concrete 8, 10 or 12″ opening, with a planed faced slide valve through which the water may be let out for any purpose, and below these gates suitable weirs for measurement are constructed. At intervals suitable waste gates are provided, and near the upper end are several sand boxes for catching and dumping any sand that may be deposited.

This method of construction is practically a new thing in California, no very extensive work of the kind having been, as far as I am aware of, previously attempted; nearly or quite all cemented conduits having been very small, or else having a cobble stone or rubble backing, with cement pointing or facing. This system has so far been a success, having stood some of it over two years and doing good service.

The six thousand or more feet of flumes in the system are built of 2″ Oregon pine dressed, shiplaped and asphalted, and present no special feature of construction. Across the main river valley the trestle consists of three pile bents of ten by ten pine piles well driven, spaced twenty feet centers; the outer piles sprung to a slight batter, 8 by 10 caps drift bolted, 4 by 14 stringers, 4 by 6 ties spaced, 4 feet centers.

The flumes as well as the development flume are all covered with 1″ redwood to prevent any contamination of the water, which is of the finest quality, and to prevent the growth of moss and fungi. The short trestles across canyons are on redwood mudsills and are lighter, six by six main and four by six batter posts with the ordinary diagonal and longitudinal bracing. The main system as at present constructed is about eleven miles in length, and has in connection at the lower end a complete pumping plant, reservoir and distributing system, to supply the lands above the gravity flow, and close to the hills

which are practically frostless and very valuable for the raising of lemons and winter vegetables. The plant consists of a complete set of pumps of the well known make of our own Mac Walker of Port Huron, of one million five hundred thousand gallons daily capacity.

The water is taken from a pumping cistern ten feet in diameter and ten feet deep, and pumped through about thirty-three hundred feet of 8″ Kalamein pipe to the reservoir, which has a capacity of eight hundred thousand gallons.

Connecting with the main, are the distributing pipes with outlets with gates as required. At each outlet is built a weir box of Portland cement concrete of varying size according to the pressure on the pipe, the less pressure the smaller the box may be, as the surface of water in the box and over the weir should be reasonably smooth in order to secure accurate measurement. The measurement over a weir is coming to be the usual form in use, instead of the square inch under a 4″ pressure, and is much easier to handle and regulate. The weirs on this system, that is, on the pipe lines, are all twelve inches wide and on the back of the weir boxes is placed a scale graduated to one-fourth inches. In the use of the water, the depth of flow and time are noted and recorded, and the flow per minute in gallons taken from a table prepared for the purpose, and has been very satisfactory.

In June, 1892, over six million gallons were pumped and the record of water used was within about fifteen thousand gallons of the same amount. Meters are used on all service connection. So far the Crown and Nash meters have been used.

The reservoir is seventy by one hundred and seventy-five feet in size at top, twelve feet deep with inside slope of one to one, and cemented four inches thick with Portland cement concrete, given two coats of neat cement wash; it is tightly covered with a light roof of sawed redwood shakes, and well ventilated at top and ends and all openings screened.

From the weir boxes the water is conducted either in cement or vitrified pipes under ground, or in small flumes of redwood, or in small surface ditches to the points desired on each subdivision, or lot, and from these points distributed over

the surface in various modes of which in detail we have no time to speak.

From this brief sketch you get some little idea of a water system and in general of the lands and waters of Southern California.

There are thousands of acres of the most beautiful lying lands still unimproved, and ample water yet undeveloped and unstored to bring them all into utility. It requires only capital and skill and a little time to accomplish the end and make "Our Italy" as nearly like the "Garden of Eden" as is possible on this earth on which we live.

MR. HODGMAN: There is one thing I want to say in connection with this paper. I do not think there is a harder working man in the Michigan Engineering Society than Mr. Reed. He has practically everything to do, engineer, superintendent, book keeper and everything else. He doesn't have a minute to spare, but whenever he could find a minute, he sat down and wrote. The men who really have the most work to do are the men whom we can best depend on to do their share of the work of the society.

MR. JOHN RANDALL: This question of cement lining is quite interesting to me, because I tried such a thing four years ago. It was in loose sand, and with only one and one half inches of cement, we hold water to the depth of sixteen feet. It has been in use four years without any leaks. I recommended that the sides should be bricked up and the bottom should be concrete and the sides and slopes should be brick, but the capital of the company would not warrant that, and they told me that I must arrange on something cheaper. As an experiment,—I thought it was an experiment to make such an egg shell as that—but we dug it out, being very careful not to disturb the sand as it was originally put down, not to break the walls, and just before the cement was put on, the mason went ahead with the trowel and shaved it down to the undisturbed sand, and put one layer of cement on while it was yet moist. We did not use any gravel in the concrete, but used a very good quality of sand, using about five of sand to one of cement.

MR. GRANVILLE: Is this a reservoir, carrying sixteen feet of water, with only a 1½ inch wall to hold it, with nothing in the bottom to hold the soil?

MR. RANDALL: Yes, but it has a good many feet of natural soil.

MR. GRANVILLE: I know, but on the bottom. Would the weight of the whole structure help strengthen the walls?

MR. RANDALL: I think the only strength it has, is in the natural packing. The land has been there, we don't know how long, pressed down by the soil above it, until it is more solid than we can get it, in any other way.

THE PRESIDENT: What slope did you give to the sides?

MR. RANDALL: We made it egg shaped, except that we had a flat place on the bottom. I think the slope as it started near the top was about one in eight, and then the slope grew greater.

THE PRESIDENT: Then it was a good deal steeper than the natural slope?

MR. RANDALL: Yes.

THE PRESIDENT: It would be difficult, it appears to me, to keep the sand from sliding in while getting the plastering on?

MR. RANDALL: We did not allow the excavation to get ahead of the plastering. We put on a thin coat to hold it, and waited until that was set before going any further. It did not cave a particle.

MR. APPLETON: It must have been a good place for that kind of work?

MR. RANDALL: Well, it was all sand.

MR. APPLETON: You couldn't use a form?

MR. RANDALL: No, just plastered right on the sand bank. It was a very simple affair, but in a good many places it would not stand.

MR. APPLETON: That is a new idea to me. I don't think under the circumstances, I should have thought of holding that much of a head of water with that amount of plastering, but I don't see why it wouldn't work.

MR. RANDALL: The natural soil holds it. The plaster is merely to keep it from leaking. I would be almost ashamed that I had any connection with such a job if it hadn't stood for four years.

MR. HODGMAN: If I understand, it was nothing more than a big cistern.

MR. APPLETON: What kind of cement did you use?

MR. RANDALL: The best Portland cement.

MR. BEAN: Commencing at the top and working down?

MR. RANDALL: Yes, we dug the sand away all around the margin to the depth of a few inches, and then plastered right on to the bank, and so on one course after another as the sand was excavated from the resevoir.

MR. HODGMAN: It seems to me that is the distinguishing point of the whole thing, *i. e.*: the manner in which the work was carried on. This was simply a big cistern, and I have seen lots of cisterns dug in the sand and plastered over with cement without any backing, which held water and stood indefinitely. I have one myself, egg shaped, which is ten feet deep, and holds over forty barrels. The hole was dug, and it was plastered right into the sand about an inch thick with mortar made from common water lime and sand. The top is arched over with brick, but the first layer of brick was laid right on the sand at least six feet above the bottom of the cistern. That has stood nearly twenty years without cracking or leaking.

MR. SKEELS: Mr. chairman, I think the principal point is the absence of any thicker backing.

MR. RANDALL: The natural earth is there, and before it was excavated, the weight of a cubit foot of the original earth was probably more than the water to be put in there afterwards. The natural soil is backing enough, and therefore you are going to a needless expense in putting in brick, etc. As far as holding the water, the natural earth is enough.

THE PRESIDENT: I do not consider that it is at all remarkable that it will hold water—it is stronger after it is full of water.

MR. APPLETON: The trouble would be at the time it was empty. You get a pressure of ten feet of water at the bottom of that well, and if the earth is at all compressible, a thin wall like that is liable to crack. The pressure at the bottom of that cistern is a good deal heavier—it isn't like a body of earth.

MR. HODGMAN: Isn't sand about the least compressible earth we have to deal with?

MR. APPLETON: But in speaking of the resistance from the inside or outside. The resistance is practically the same at the bottom and top of that well, on the outside of the well where you have the backing of sand, but the pressure is greater at the bottom of the cistern full of water than it is at the top.

MR. RANDALL: You have got to bear in mind that this is egg-shaped, and the pressure from above would distribute it all over.

THE PRESIDENT: I suppose that the safety of the structure arises from the fact that you were careful not to allow any loose material to get in the lining. All of us know there is nothing better than sand, so long as you can keep it confined. It is better than solid rock, provided you can only keep it confined, and in this case the precaution seems to have had its effect; but it certainly is an extraordinary case, and it is just these little tricks of the trade that we ought to have brought out in these meetings of ours.

MR. GRANVILLE: How was the water put into the cistern after it was finished?

MR. RANDALL: Pumped in through a pipe in the side. There was a four inch main put in while the reservoir was being constructed. The last thirty feet was driven from the inside, by working the dirt out of the inside of the pipe, so as make sure that the sand was tight outside of the pipe.

SPECIFICATIONS.

BY G. L. WELLS.

Specifications prepared for proposed engineering works are for the purpose of giving every person connected with the work an accurate idea of the *quality* of the work to be performed and materials furnished. They should also include a statement of quantities, as nearly as can be arrived at from the amount of preliminary work which the projectors choose to spend in gathering the necessary data.

Most corporations having work of any magnitude invite contractors to bid upon it, offering as the basis of the bids and contract a set of specifications, descriptive of desired materials, manner of placing, and quality of workmanship.

The specifications are supposed to have been prepared by a competent engineer, whose skill and experience will be manifested in the specifications themselves.

But is this always the case? An advertisement for bids generally secures a number of proposals from reliable contractors who desire the contract for the profits which can be realized by their skill in management.

As labor and material cost money, the contractor has to figure upon the cost of these in making up his proposal. When he comes across a paragraph like the following, how can he determine quantities to be used?

"All mortar used for masonry and concrete shall be made of fresh hydraulic cement, of such brand and strength, and mixed in such proportions as shall satisfy the engineer in charge."

It is a principle in law, that in making contracts, minds must meet.

Where could minds meet on the quality of mortar to be used by such a description, when cements are in the market which vary in cost from 60 cents to $4.00 per barrel, and the proportion of cement to sand are demanded from ratios of 1:1 to 1:3?

The mind of the bidder at least, in this case, is puzzled instead of meeting the mind which produced such a description, and the engineer gains their contempt instead of respect.

An invitation to bid upon a complete pumping plant without telling distances between boilers and pumps, or giving drawings showing their relative positions, leaves each bidder to supply what ought to have been given them exactly, or to bid upon a stand pipe which has only a definite description of diameter and height, leaves each bidder to supply a set of specifications of thicknesses with varying factors of safety.

A fair comparison of bids can hardly be made from such specifications, and the engineer who made them merits the contempt which both his employers and contractors heap upon him.

"Any extra work required under this contract shall be executed as directed by the chief engineer, and shall be paid for at a price fixed by him, which shall be final and conclusive."

The above expression is often met in specifications, and to say the least is a one-sided bargain.

If the engineer is known to the contractor, and his fairness established, the matter is not so uncertain; but in the present day of competition, it is no unusual thing to find contractors traveling from one thousand to two thousand miles to bid upon work, and it is then impossible to know what to expect from an engineer who is an entire stranger to them, and compensation for extra work ought to be stated in a more definite and certain manner.

Customs of workmen, such as brick and stone masons, plasterers, painters, etc., in measuring work differ materially in different localities and the method of work should be accurately described. For instance, if a man makes a bid calculating that 128 cubic feet make a cord of stone, and then when he comes to do the work finds that all local contractors and masons figure 100 cubic feet in a cord, with all corners figured twice, he furnishes 28 cubic feet for nothing.

There is an effort being made by many engineers to reduce such work to a uniform practice of measuring such work by

the cubic yard, actual measurement, and do away with the senseless customs used by workmen, which differ even in the same state, but the knowledge of this reform has not reached all parts of the country yet, as many recent sets of specifications will testify.

In short, if an engineer will constantly keep before him the *quality* and *quantity* of the work, his specifications will be such that contractors can figure intelligently, and will avoid future misunderstandings and litigation.

It is not always possible to give an exact statement of the gross amount of material to be used in the work. It can be approximated near enough for practical purposes, but the unit of measurement should be accurately defined.

The quality of the work can always be described in such certain language that no one can mistake its meaning, and a man who cannot do so is not worthy to be classed among engineers.

The President: It is very certain that a man who has occasion to consult specifications for public works comes across some very queer specimens.

Mr. Sellers: I would like some of you gentlemen to call at my office. We have some specifications prepared by Mr. LaRue and myself, that I think cover this ground entirely.

Mr. Granville: Measurements ought to be put in cubic yards. The difficulty is in measuring masonry where there are openings, and there will always be difficulty in settling with contractors, unless these matters are put into specifications. It is a matter that requires a great deal of care, but as a unit of measurement, we should not think of anything but a cubic yard. There is one extreme that engineers are likely to run into, and that is to tie the contractor down so tight that there is no chance for him at all. I have seen specifications so severe, that it would be impossible, in nine cases out of ten, for any contractor to comply with them. To be sure, there is opportunity given to the engineer to let up, but that is an objectionable feature. Nothing should be left simply to the judgment of the engineer, unless it is something that cannot be

foreseen. Circumstances are liable to arise in the execution of any important work that cannot be provided for, but where it is possible, it should be done in the specifications. But they should not attempt to be so severe with the contractor that he cannot carry out the specifications, as they are liable to drive away honest men.

MR. APPLETON: That is a good point. There is too much in many specifications—more than anybody has any idea of carrying out. If a contractor figures on carrying out a contract to the letter, he can never compete with others who do not expect to carry out the little points. My idea is to put what is absolutely necessary in the specifications, and leave out that part which you do not intend to enforce.

THE PRESIDENT: By attempting to put in too much, you are very apt to compel men, who intend to be honest in their bids, to put on a good deal higher price than they are really willing to do the work for.

MR. GRANVILLE: Of course, sometimes, if you happen to know the engineer, you are all right, but you have the advantage of some other man who doesn't know the engineer. I mean by that if you know the habits of the engineer, and his custom in enforcing his specifications, you have the advantage of the stranger.

THE PRESIDENT: And there is a great difference in engineers—in their judgment in the enforcement of specifications. Some men will insist on the exact performance of the specifications when the thing is almost impossible, while an old, experienced engineer, who has had a great deal of that kind of thing to do, will know when to require exactitude and when not to.

METHODS IN VILLAGE AND CEMETERY SURVEYING.

F. L. CHURCH.

Doubtless all who have had experience in surveying village and cemetery plats know the difficulty of getting measures on parallel lines to agree, particularly when the ground is uneven or obstructed to any extent, as it usually is in standing timber. We are also well aware that it is impracticable to run successive lines with a compass that will be exactly parallel without correcting them. If the work must be done with a compass, then lines should be measured and stakes set on opposite sides of the plat, and lines opened and corrected between these stakes, before the staking is done. But I think that an instrument that will measure angles is, if not indispensable, at least very desirable, and any surveyor who wishes to do this kind of work should provide himself with one. The methods that I wish to mention were worked out with a Gurley Reconnaissance Transit, trying to overcome the difficulties I have mentioned.

While I do not claim that they are better than any other, I have found them useful to me.

Of course the first thing to ascertain, is the plan of the plat, and if the adjoining sides are not at right angles, then the side to which the lots are to be squared must be decided upon. I have known of plats being laid out with adjacent sides of all lots not at right angles, but it seems to me that this is a very undesirable plan; still it is a point to be decided by the proprietor rather than the surveyor. Then if the land is tolerably level, measure either at right angles with or parallel to the guiding line, carefully set a row of stakes, marking the exact point with a tack, measuring and sighting again after the stake has been driven solid. Sometimes it takes considerable explanation to make the "hands" comprehend your plan, though if they are men of usual intelligence, they will learn it in a short time. That is one way in which land surveyors are

at a disadvantage with railway surveyors, because they must get along with untrained men in most cases, and by the time the men begin to know how to do the work well, as you want it done, the job is finished; and for the next, a new set of men have to be got along with. This makes it necessary to watch the work for errors and to check measures in every way possible. At one time after telling my men what to do, so I thought they understood, instead of measuring and lining on top of the stake for the position of the tack, they drove the tack in top of the stake, and then set the color pole on the tack, and if it was not right, tried to move the stake to get it right, which is a troublesome thing to do. This row of stakes being set correctly, select a line at right angles with it, which will give the best ground to measure on and set and mark stakes in the same way. These two lines of stakes will be the frame work of the plat. It will usually save labor to set stakes while running in the direction in which they stand closest together, that across the ends of the lots.

Having decided which way you will run while measuring, put sight pickets at each end of the base line which is at right angles to the lines you will run, and at all needed points, to have one or more in sight from every stake on the base line; being careful to get them set firmly and exactly right. This is best attended to when running the line; commencing at one end of the plat, set the transit over one of the tack-marked stakes, ranging it by the pickets, and then turn the telescope 90° and open and measure the line. Except the first few stakes, set the stakes lightly, so that they may be moved if they need it, to correct the measure.

A good way to measure, is to have one of the chainmen set the marking pins where stakes are to be set and let the stake driver follow with the stakes, but not move a pin until the next one is set, so as to measnre from a pin and not from a stake. Proceed in this manner until the stakes are set.

Now, to correct these stakes, place pickets on the base line parallel with lines to be corrected the same as on the first base line. Then set on this base line, as before on the other, and then turn 90° and sight through to each stake, thus crossing

the lines run before, and move each one that needs it, to make it agree with the measures on the base line. It probably will not be necessary to cross-sight every row of stakes, but one in three, or the more important ones if the plat is in timber will answer, and save work; as one or two may be measured to, and corrected each way from those that are sighted. If the lots in different parts of the plat lie in different directions, each part would have to be worked as though it was an independent plat. Different sized lots would make more base lines necessary.

Sometimes on account of rough or hilly ground, better results will be obtained by making one line a base line part way, and another the rest.

To illustrate my meaning, I will give an example: The northwest corner of a plat I surveyed was at the foot of a hill facing west, and it was steep enough to make a correct measure difficult. Along the west boundary it was nearly level and the hill turned to the east, so that on the south part of the plat a level line was obtained long enough to reach as far east as the top of the hill on the north side of the plat, so I corrected the west end from measures on the south side of the plat and then ran a line at right angles up on top and across the hill, and corrected the east end from a base line near the north side. The stakes were set running east and west.

Another plat had a bold hill projecting into it from the east, and in order to get a correct measure of the east boundary as well as correct location of two rows of stakes over the hill, I ran a line west parallel with the south boundary, then went north with the east boundary until I got north of the hill, then ran back parallel with the south boundary, and am satisfied that I got better results than I could have got by measuring over it. On hilly and rough ground there will often be a chance for the exercise of judgment in deciding where to locate base lines, and no rule can be given, except to make measures to correct from, carefully, on the best ground you have, and start all measures from lines which are as correct as you can get them. The angles of the boundary must be correctly measured, and the stakes on or next to either of them and not parallel with either base line can still be run from the

intersecting base and corrected from the other, by knowing the angle. If lots are not right angled, but have their sides parallel to one boundary and their ends to the other, the same plan can be used by turning the proper angle instead of 90°. It will help to avoid mistakes in turning angles to always keep the limb so that the vernier reads 0 with the telescope directed along the same line, or direction, say the one running nearest north, then note the reading on the limb when turned in the direction of each line of the plat.

The same method may be used in cemetery work to good advantage when quite a number of lots are laid out of the same size. In curve and irregular work the bearings may still be taken by angles from lines, the direction of which is known, taking care to have a sufficient number of hubs or turning points on all lines likely to be used for this purpose, as well as at all points where lines in different directions start, to be able to get the direction of the line wherever it is needed. It will be seen that the object is to get the lines correct in direction without correcting them, which may be done within narrow limits by angles from lines the direction of which is known, if care is taken; and to make all measures agree with those that are presumably the best.

I wish to make a query in regard to the location of monuments. Though it is not covered by the title of my paper, it is closely related with it. Where is the best place to put the monuments for the intersection of streets or streets and alleys? If they are put at the intersection of side lines, that is, at lot corners, they are in the way of fences; if put in at the center intersection they are handy to work from, but are apt to be disturbed in making and working the street, and if the streets are ever made good will be destroyed, or be badly in the way. I have set some both ways and do not like either. I think now that a good way is to set them four or five feet from the lot corner. I have set some in this way putting them in line one way with the stakes and four or five out in the street the other way; at alleys I put them in the center of the alley.

I should like to know the opinion and practice of others.

My purpose in writing this has been as much to find out

the methods of others as to give my own, as I have never seen any description of methods for this purpose, and if I can get anything better I should like to do so.

METHODS EMPLOYED IN LAYING OUT A TOWN PLAT.

BY A. J. TEED.

During the past summer I have had occasion to survey and plat into town lots a tract of about 300 acres. Some of the methods employed in doing the work may be of interest to surveyors, even if they are not new or instructive.

The land was nearly level and while covered with stumps and logs, there were no more trees or bushes to obstruct the line of sight than could be removed. I could get in all cases, an unobstructed view, and on some of the boundaries there was a good place to measure, so there was no reason why accurate work could not be done.

As the land was likely to become valuable, I determined to forstall the future profits of lawyers, accruing from litigation that should arise over my mistakes, by doing accurate work.

The land was bounded on the north by a level and well cleaned wagon road, and was traversed by three straight railroad lines. These roads afforded an excellent place to measure, but the east and west quarter line, the west section line, and the west boundary of the plat must be measured over stumps and logs. To make the measurements on these lines agree exactly with those on the railroad was the task I undertook to accomplish.

Owing to the right of property owners, it was necessary to make the streets conform to the government survey. As the government surveyors did not use a transit and steel tape in their survey of this section, the angles were not right angles, and the lines were not straight. In fact, there is not a single right angle in the entire plat. Those angles that appear to be right angles, vary from 3 to 18′.

I ignored the eighth lines and made all east and west streets parallel with the east and west quarter line, and all north and south streets parallel with the north and south section line. As the plat is partly in two sections, this made a small angle in each street as they cross the section and quarter lines.

The method employed in the survey was to work from the outside in, from the great to the small. The boundaries were first established, and then the interior street lines were run, setting monuments at their intersections. The blocks were then subdivided into lots.

A brother surveyor once remarked to me: "That he knew of some men just mean enough to kick, if a surveyor varied a foot in the boundary of a lot." In this plat I believe that there is not a single block the boundaries of which vary more than one inch from what they were intended to be, and as each block line is again sub-divided into from 6 to 8 parts, I believe that the greatest average variation of any one lot will not exceed one-fourth inch, and generally, it will not exceed one-eight to one-sixteenth of an inch from the size it was intended to be.

If it takes a mean man to kick on the variation of one foot in the size of a lot, the exact amount of meanness a man must possess to kick on this survey can be mathematically calculated by the principle of general average.

The transit used in this survey I put in perfect adjustment, so far as the line of collimation is concerned, but I did not have confidence in its ability to measure an angle to less than 1′. But in all the principal angles I took at least four independent observations, as the sum of all the external angles in the principal triangles over quadrilaterals equaled four right angles to within less than 1′. I feel confident that I have all the angles correct to within less than ½′.

The labor of making the measurements was facilitated by the presence of the three railroads that crossed the plat. The east and west quarter line had to be measured on the natural ground. I measured the line three times and the greatest variation was 1½ inches in one-quarter mile.

To get the correct distance between the streets on the

north and south lines, I carefully measured the angles of the two north and south railroads from the north and south streets, and multiplied the secant of these angles by the distance between the streets, and laid that distance off on the railroad and put in points.

At first I thought that a variation of a few minutes in the angles of the railroads would make no perceptible difference in the length of the secants, but I found that to make the distance on each railroad from where they cross the quarter line to their intersection agree, the angles must be exact. That a a variation in the angle of the Cummer railroad of 2′ would vitiate the entire survey.

Having established the points for the intersecting streets on these two railroads to my satisfaction, I proceeded to measure the west section line. The ground here not being so regular, it was more difficult to get an accurate measurement. After measuring the line carefully as I could, I found it necessary to add nearly one inch to each block of 366 feet, to make the entire line agree with the calculated distance as determined by the measurements on the railroads.

Having established points on the two railroads, and on the section line, I set the transit over each point on the Cummer railroad and back-sighted to a flag held on the G. R. & I. railroad, and then ahead to a flag at the corresponding point on the section line. In every case I found the line practically straight.

Assuming that to be correct, all intermediate points were lined in, independently of the chaining.

The point on the north and south streets were set by sighting from the north boundary to the quarter line, and from the quarter line to points on the T. & A. A., set in the same manner as those on the north and south railroads.

As I had on this survey most of the time only one man to assist me, all the intermediate street lines were chained; but no attempt was made to do the work accurately, and the lining was all done with the eye.

It is an easy matter to thus set points 300 or 400 feet apart, that will not be more than three or four inches out of place,

but to set them so that they will not vary more than one-half inch by the chain alone, is a very difficult operation. The intermediate points thus set by the chain, which were approximately correct, were then lined in with the transit.

During the progress of the survey, the intersecting points were marked by small pegs, about one inch square, and points marked on them by means of tacks. By using small pegs, a man can carry enough for a line a half mile long in his coat pocket, or tied up with a string, without being a burden to him; thus saving the expense of an extra man to carry stakes, besides, small stakes can be inserted in the ground more quickly and more accurately than large ones. After these points had all been established, they were replaced by pieces of gas pipe three to five feet long.

In order to get the gas pipe in the right position, I used a stick about three feet long with a little notch cut in the middle, and one near each end. The middle notch was laid exactly over the tack, and a pin inserted in the ground in the notch at each end. The stick being removed, the gas pipes were then driven in the hole where the peg stood, nearly to the surface of the ground; the stick was then replaced and the pipe was wedged over to the exact position and driven out of sight.

In this plat, the north and south streets all make an angle of 8′ on the quarter line, and the east and west streets make an angle of 18′ on the section line. To test the accuracy of the chaining this angle of deflection was measured on each street, and when it did not read the same, the error was discovered and corrected, so that on the entire plat the work of the tape was everywhere checked by the transit, and the work of the transit was checked by the tape. Perhaps the most interesting part of this surveying was my experience with tapes.

I used on this survey a tape obtained from Justus Roe, in connection with an old Hodgman tape, which I had adjusted to a standard tape which I had had for fifteen years. The Roe tape was just a quarter inch shorter in a 100 than my standard.

In using the Roe tape I attempted to make the work agree with my old tape, by adding one quarter inch per 100 to each

line measured. But upon trial I found that this was not enough. Measuring one-half mile along the level grade of a railroad track, the best place in the world to measure, after allowing the quarter inch per 100, the Roe tape was still too short. I can account for this difference only by the different methods in which the pins are set. In my old tape the distances are taken from a line on the tape held to the *center* of the pin. In the Roe tape the distances are taken from the *front* side of the pin.

Theoretically, these methods ought to give the same results, but the two tapes would not measure the same, and I found the difference to be about one quarter inch in 400 feet.

This difference however, is comparatively small, and might, I suppose, be eliminated by more care in setting the pins, But which of these two tapes is correct, as to its recorded length?

My old tape I obtained from Hodgman, but as I found it one-half inch too short, I regraduated it to agree with my standard. This standard I obtained from Gurley and have compared it with a number of good tapes, and believe it to be right. Recently I compared tapes with the engineers of one of our railroads, and his tape did not agree with any of mine. Now which of these four tapes is right? My Gurly tape is warranted to be correct according to the U. S. Survey thereof.

The Hodgman tape is made from a steel rod furnished by the Government, and is absolutely correct.

The Roe tape I returned, because it was too short, and they write me that they have compared it with the U. S. standard, in the coast survey office of the city of New York, and it is exactly correct.

The railroad engineer's tape has been tested by the Supreme Court and must be right.

Here are four tapes, each one warranted to be correct by the U. S. standard, and yet each one is different. The greatest difference being one-half inch; the Gurley tape being the longest, and the Hodgman tape the shortest. It seems to me that there are about as many U. S. standards as there are

political parties. The democrats and republicans on the extreme, and the prohibitionists and the peoples party waging between. If there is a member of this society who has a tape which he knows to be correct, I would like to obtain his photograph, not of his tape, but of the man; for I am tired of looking at absolutely correct tapes.

THE PRESIDENT: Gentlemen, these papers are before you for any discussion. If anybody thinks it is easy to lay off a large piece of land, and come right every time, he will find it easier than I ever did.

MR. BEAN: If they can make the second measure come out like the first, they can do better than I can.

MR. HODGMAN: My general method has been pretty much the same as Mr. Church's. I have a son who has worked with me ever since he was old enough to carry a pole in his hand, until he left me for a better job. After having laid out these base lines, I have run the interior lines and set the stakes without measuring at all, by sighting both ways—with his assistance—and all the interior work was done by sighting both ways. I stand on one line and sight toward a picket on the opposite side of the block; my son stands on the other line crossing it and sights to a picket the other way, and the rodman stands with a rod held plumb, moving it as we direct, until it is exactly in line both ways. All the stakes are rapidly placed in line both ways without measuring any but the outside row.

THE PRESIDENT: That will answer very well where the ground is perfectly clear of timber, but suppose you are in an old pinery ground covered with logs and blackberry brush?

MR. HODGMAN: Do the best you can then.

MR. HUBBELL: I have had a little experience on rough land, and have tried Mr. Hodgman's plan, and found it very satisfactory, especially over rough land. I have often used two instruments, having a man who was capable of using one himself. As for monuments, I had supposed that the centre line of streets and alleys was the proper place. I have used a ¾″ iron rod, driving it to the surface of the ground, and then witnessing it by some temporary post or stick, that would indicate the approximate neighborhood.

MR. HODGMAN: A few years ago I took occasion to write to the civil engineers of nearly all the leading cities of the United States, asking them the question as to what kind of monuments they used, and where they were placed. The result was a very motley set of returns, which showed that very few of the leading cities had any monuments worthy the name. We found some of them set their monuments on the angles outside of the street, at the margin, right on the corner lot, some in the middle of the street, and some of them set them on some arbitrary line—some line, neither the centre of the street nor the side line. I made up my mind that the best place of all, even supposing they are liable to be disturbed, is the center line of the street, and make enough observations to permanent objects near by, so we can re-locate the point.

MR. HUBBELL: That is the best place undoubtedly, until you begin to put sewers into the street.

MR. HODGMAN: Of course that is the trouble—their being destroyed,—but as I said, I would take enough references to permanent points, and then I would make it a punishable offence to disturb them without the authority of the engineer, and see that they were punished if they did it.

THE PRESIDENT: And to do that, you would have to make one man judge, jury and executioner, otherwise you couldn't do it. In Manistee there was a time when there were a great many good monuments, and not half of them can be found now. They were almost all left, and pretty well taken care of until we began to put sewers in. I supposed the location of them, as Mr. Hubbell says, was arbitrarily settled by law; that they had to be at the intersections of streets and alleys.

MR. HUBBELL: I wrote to the Auditor-General in regard to that point, and he says that any of those points, if uniform throughout the plat, will be accepted at their office as correct. I have set some at the lot corners, some on center intersections, and some four feet from lot corners, and all were accepted.

MR. HODGMAN: What do you use for monuments?

MR. HUBBELL: I have used gas pipe considerably, and I have used cedar posts, a foot or more long.

MR. ALBERTSON: I was a little surprised in looking at the plats in the Auditor-General's office, to see that one of the permanent monuments consisted of an oak stake 1½ inches square and 15 inches long. That might be serviceable in a town with a junk shop!

MR. HODGMAN: We want for a monument something that is not liable to be destroyed by the boys. There is a post that is made by a Jackson company, but it has to be protected because it is readily broken. A good wooden stake well driven is a more permanent monument than a wrought iron rod or gas pipe. The stakes, although they rot away, will yet, if they are driven below the surface dirt, last indefinitely. I have dug them up where they had been down for sixty years. The rotten wood is just as good a mark of the location as the sound wood is, and in some localities it will last an unknown length of time.

MR. SELLERS: This summer I platted a sub-division. At the corners I placed stakes four inches square and two feet long; the intervening lot stakes were 18 inches long, and no questions were asked as to what they were or where they were placed.

MR. VINCENT: When they come to build fences, what becomes of those corner stakes?

MR. SELLERS: The corner stakes are more liable to destruction than the center lines. You may take the greatest pains, and the first thing they do is to dig them out.

MR. VINCENT: I don't think you are troubled with fire, as we in the north are, in Copemish and towns of that kind. The wooden stakes only last until a man clears off his lot, and half of the time his lot is cleared by fire.

MR. HODGMAN: In our part of the state, the fire only burns the top of the stake off.

MR. VINCENT: Yes, but there are a good many stakes driven around, and every summer the fire burns off the top of them and the finding of one wooden stake isn't very satisfactory evidence to me. I am surprised that our Auditor-General takes plats without something beside wooden stakes. I have taken a great deal of pains. The last village I platted, it took

109 to mark the intersection of streets and alleys, and it took a great deal of iron, and I am glad to know that we can use wooden pegs; it simplifies matters. But by using iron stakes, if one is gone you can find the others, and I, myself, should be very loath to give them up. I find that up in the northern towns, after they get their lots cleared off, the wooden stakes are pretty scarce. They burn off and are raked off. It is different in cleared land, but I should insist on something more than wooden stakes in a village plat. For the corners of boundaries I have used gas pipe two feet long, or buried a beer bottle, or something of that kind, and I have found it a pretty good way to put a corner down deep, at least three feet down; make a post hole and let your plumb locate that nicely, and then take ordinary bricks and make a little pier to the surface. They will plow up two or three, but some will remain.

Mr. Strong: Speaking of a wooden stake, and its being a proper monument, I wish to say that I was up in the Auditor's office, and that the first two plats in the last book are from Detroit, and the monuments used were oak stakes, 1¼ inches in diameter. I asked the Auditor if such stakes would answer the purpose of the law, and he said the carrying out of this law depended upon the honesty of the surveyor. I said something further, about witnessing these monuments. I don't know as I ought to say it here, because many of us do not witness the monuments we ought to, and where we do, they are written down in the note books, and not on the plat. The law says that we shall monument all of these corners at the ends of the streets and alleys; it says furthermore, they shall be witnessed by permanent objects. The words are: "They shall be witnessed," but if you have witnessed them where is the place to show it, if not on that plat. Now it may be that 1¼ inch stake is a monument, and then maybe it is not. So far as I am concerned, I have no desire to put in a 1¼ inch stake, and certify to its being a monument, and I think we ought to carry out this law in respect to witnesses. The day is coming when there will be some men in this office that will say to these engineers, have you witnessed these monuments? "Yes, got it in my note book." Does that answer the purpose of the

law? We know better. Now it is time, if it is necessary to have our witnesses written in the plat, that we should know it, and begin early enough so we won't be dead and gone before a start is made.

Mr. Church: The difficulty in the way of the plan the gentleman has spoken of, is that most places where there are trees that can be marked as witnesses, they are usually soon cleared off. If it was an old place where you had the assurance that the trees would be left, I think it would be a very good plan, but I myself, have never surveyed a plat yet, where there was an assurance that a single tree would remain.

Mr. Bean: This question of monuments is a very essential one. There is a way of putting in wooden stakes that will answer very well. Take an ordinary stake, prepare your hole and fill it full of lime; then put in your stake and you have a pretty good monument. If they take the stake out, they will have to take out all of the lime at the bottom of the pit before they can destroy the position of that stake. Speaking about iron stakes, I notice that most of those here have mentioned gas pipe. If you are going to put in iron, cast iron is away ahead of wrought iron; cast iron water pipe has been laid for 100 years in New York city, and upon examination they could notice but very little depreciation in its value, but an ordinary gas pipe will rust out in a very short time.

Now, in regard to position of stakes—the centre or sides of the street. I have used both methods; another method I have adopted, is to put the stake out perhaps two feet from the corner intersection, and bore a hole six feet deep and put in lime or pulverized brick. If you put the stake at the corner, the first man that builds his fence will be very certain to dig that post out, and when you come around, he will tell you that the corner post is the exact point—he has taken pains to observe that point. But if you will set your monument in the street 18 inches, you will probably clear his post, and more especially if you fill the hole up with lime.

Another thing in regard to witnesses. Of course it is a hard matter to make witnesses of plats at the corners. If you had for instance, good permanent buildings, or where you were

taking measurements to the base of these walls, you would have something that would last. I would like the Society's opinion in regard to taking witness trees in the country. What is the preferable timber to use for witness trees? My experience has been, that a large hickory tree is the best, although when I was in the Government Survey, we were allowed to take anything except a hickory tree, even a poplar. True, the hickory is a short lived tree, but how about determining the position of that tree by a tap root. I have been surveying in Jackson county for a long time, and I think I have never failed in determining a corner to my satisfaction when I had a large hickory. When I examined my notes and found a good hickory for a witness, I found I could establish my corner.

Mr. Goodale: It seem to me if we place our monuments 18 inches or four feet from the block corner, that it is going to be right under the sidewalk. In my practice I have used the centre of the street mostly. I think by planting them well, they will be less disturbed there until the catch basins are put in.

Mr. Bean: I would say in connection with that—that would be where I would like to look for them. There are corners in Jackson which I would give $100 to locate. If I could locate them by taking up a block walk I would do it in a minute,

Mr. Doane: I have found the most satisfaction by securing the boundaries, and then I know where to go to work. I platted an 80 acres a few years ago and I got all of the boundaries. It was entirely covered by woods. I measured the boundaries very carefully, and then I knew exactly how far it would be across by computation, and then when I came to measure across by short lines, I found out if the measurement corresponded. In some places I put in iron stakes at the centre of intersection and others at the corners of the streets. I like to put them in at both places. Of course where you are in the woods, wooden stakes are very apt to to burn out, and you must have something that fire will not destroy, and still you usually find Government stakes that are not burned out,—if they are not decayed.

One objection to setting the post 18 inches or two feet from where it belongs, is that they are very apt to use that as a corner, unless you put the monument down as deep as Mr. Bean has suggested. I found such a case in surveying a section. It had been surveyed in 1877, re-surveyed, and they planted a corner two rods east of the true corner, for a witness corner and witnessed to that. The country was partly settled up at that time, and they went on and used that as the true corner; I was called to establish that corner a few days ago, and I found that in dividing it up, it brought that corner about two rods east of the point equi-distant, and it had been used probably for eighteen or twenty years as the true corner, there was a high-way built a mile north and south, and all the conveyances went to that corner, the gentlemen on the east was very anxious I should place that corner equi-distant between the section corners. I hardly felt as I wanted the responsibility of bringing on a law suit, so I told him I thought the true corner stone might be two rods west, and if he wanted to secure legal advice and go to law about it, I should not try to hinder him, butI shouldn't set the corner two rods west of there and pretend to say he could hold to it.

Mr. Bean: I would put these corners for permanent monuments only for blocks, two corners for each one, boring down about six feet, and these monuments I would put below the surface and leave a stake at the proper corner. If you could establish your block without any difficulty, there is no trouble then in making your lot corners; it is a little objectionable to have them under the sidewalk, but it is a pretty safe place.

Mr. Doane: In Gladwin, they have put their sidewalks all six feet from the street line, and left the space between for planting trees, and it makes a very pretty appearance, and would not disturb the monuments, although it makes the street a little narrow. That is the way their entire village sidewalks are laid out with the exception of the main streets; their sidewalks are six feet wide and on the main streets they are 12 feet wide.

Mr. Hubbell: I get the exterior boundaries and measure

them carefully; at those corners I put good monuments, and those corners I witness with trees if I can get them, and these witness trees I record on the plat. The interior work, I do not attempt to witness, this intersection of street corners. If I can find the outer lines, I can find the inside.

Mr. Vincent: Mr. Bean spoke of a hole, and filling it with lime. Now that may do very well in a clay country, where the hole will keep its form, but in our sandy country, and by the time the old surveyor had dug down two or three times, and the new surveyor five or six times, I think it would be very distracting.

Mr. Skeels: I think the best spot for a monument is right where it belongs. Find that place and put it there, whether under the sidewalk, in the centre of the street, or wherever it may be, and the best corner I have ever used or seen was to to take a post-auger, with a handle six feet long, and with it bore a hole; then take our common brick, and put one at the bottom and fill around it; lay another across and another on top of that, and fill in around them. In scraping or plowing, you disturb but one brick,—the others are there.

A party came into the office one day and wanted I should set some iron stakes at the corner of his lots. He would furnish the stakes. He said he wanted to put a nut on the upper end of the stake. I told him to put the nut so there would be 1½ inches of the stake through the nut, and put that end in the ground. He asked the reason, and I told him, and we set the corners in that way, and they have never been pulled up. Travelling through Richmond, Indiana, I noticed on the corner where the cement sidewalks were built, and within the stone flagging at the corner of the street was a stone about three inches square, with a cross in it. I noticed it and made up my mind it was the corner of the block. I travelled around a mile or so, and at each block corner, if it was a stone walk, there had been a hole cut through the stone, and that cross was there. If it was a cement walk, it was there; and if it was a board walk, that stone came up just flush with the walk, with that cross on. That was a good plan. Anything that we can get, and have it durable, will answer.

So long as the timber is standing it is all right, and it shows the disposition of the operator to do his work and do it well, if he uses them for witnesses, but it is of short duration. The proper thing is a good monument in the right place.

MR. HODGMAN: The brick plan is pretty good, so far as its durability is concerned. The failing is that it is not sufficiently definite, even if you have got a whole brick there. In the outset, where a few inches does not amount to much, that is all right, but if it is in the city of Grand Rapids or Detroit, we want measurements more definite than the brick. I think, practically, as Mr. Skeels said a year ago, this whole question is fully treated in my Manual. I have restored, in the past few years, something like 2,000 government corners, and have used, almost entirely, the monuments made by the Jackson Fire Clay Co. I bore a hole three or four feet deep and put one above another, packing around them with the best material I can get. These monuments have the advantage that they have a cross marked on the top of them, and you can locate the exact point as long as they stay there; and they have the advantage of the brick, in that, if the top gets knocked off, there are more below to mark the place. If there is anything more desirable, I should like to know it.

I think Mr. Bean is right about the hickory trees. I have had lots of experience in hunting witness trees and corners. I guess Mr. Bean and I have done more of that work than any other two men in Michigan. I find that white oak is pretty good, too. They have tap roots that give you a pointer to tell where to go for your stake.

MR. BEAN: One suggestion in reference to taking out a stake from a place where you have any lime. Now, there is the great trouble,—about 99 men in 100 do not know how to use a shovel around the corner. They will obliterate the whole thing in about five minutes. Now, supposing you have a hole here and put in two inches of lime, six feet deep. I would ask the gentlemen if it is necessary to dig all that out in order to know it is lime. Just the moment you come to the lime, that is all there is of it. You put a stone in the centre of a street or a country road, and the first man that is at work on

the road will hook a plow on it and pull it out, but the lime he will remove just the depth of the plowing. You can identify the corner, too, just as well, by following down where the stake has polished a way, as though the stake stood there, but if you go and take the ground up two or three feet deep, the game is up.

Mr. Hodgman: Now, if I were going to put in lime, I would use the best Portland cement. The lime itself is soluble in water, and dissolves in a short time—that is, common quick lime. If I were going to put it in, I would use a hydraulic lime, or any substance that is durable and can be put in in that way.

Mr. Appleton: When we came in, Mr. Chairman, they were talking about the proper place, the centre of the street, the corner of the block. Right in this town, to my knowledge, more monuments have been destroyed that were situated in the middle of the street, since the improvements have been going on there, than anywhere else you could speak of. Of course, if it is a section corner or something of that kind, there is the place for it, but if it simply marks an intersection or the corner of a block, it seems to me you could hardly set it in a poorer place than the centre of the street. Down in the lower end of this town there is one monument that governs the whole of North Lansing. I was City Engineer at the time and was very careful to preserve it. When we put a sewer down there, I measured very accurately and restored the place; I could not do otherwise, because the records called for a monument there, but there was quicksand where the sewer was put in, and the entire thing fell in, monument and all. The same thing happened again, and now I don't believe there is a man who can go and restore that monument within ten square feet. I found a piece of iron there, and notwithstanding I begged and prayed the contractor to let that monument alone, blessed if he didn't pull it out. I think the witnesses called for 90 links from the door of a blacksmith shop, and the blacksmith shop was burned down twenty years ago. Of course, it is all right enough to put things in the centre of the street, but, if you can, put them at the corner of the block.

MR. HODGMAN: It may not be out of place to describe the manner in which the monuments in Kalamazoo are located. A stone monument is placed at the centre intersection; in a little pit, and around that pit is an iron casting, I think it is a casting such as is used for a lamp hole, and then that is covered with a conical cast iron cover that comes up flush with the pavement. For some purposes, the simple cover answers,—if you want to be more exact, lift the cover. I think there is very little danger of any of these monuments ever being disturbed.

MR. APPLETON: There is a class of people that seem to delight in disturbing monuments.

MR. HODGMAN: I guess you cannot put in any monument that cannot be taken out, or that won't be taken out in some instances, but on the whole, I think the centre of the street is as little liable to be disturbed as any.

MR. SKEELS: So far as that is concerned, there is just as much liability to destroy a monument at the corner of a block as at the centre of the street. We that have been interested in excavations for buildings know this. You get your area wall out nine to fourteen feet from the corner of the block proper, and there is no way of perpetuating it only by the block itself, and you can't do it any other way, only to do it, and take care of it after it is done.

MR. HODGMAN: Referring to standards of measure, I think it is just exactly as Mr. Teed has said, there are a great many standards that are sent out; and all are guaranteed to be United States standards, yet they do not agree among themselves.

MR. ROGERS: It has been suggested that it would be a good thing if we had a standard in Lansing, then we could test them and have a uniform standard among ourselves.

MR. WILLIAMS: How many acres were there surveyed?

MR. TEED. About three hundred, part of it was included in the frame-work, but I have not charged for that yet.

MR. CHURCH: Can you put that on a plat in this state? The law says the paper must be 18 by 24 inches; can you get that on it?

MR. TEED: The bill sent in for the stakes was for 2250; there are over 1000 lots in the business there.

THE PRESIDENT: Mr. Church asks how you managed to get that plat on the paper of the size required by the statute?

MR. TEED: I did not put it on; in the first place, it is not done yet. The survey was made, but the plat is not finished; but when I finish, I will put on all the sheet holds, and put the rest on another sheet.

MR. ROGERS: I can answer Mr. Church's question; I had occasion to plat 800 acres into 500 lots, and the plat is in four parts, number 1, 2, 3, 4, and one sheet is given entirely to the description making five sheets in all; 15 pieces of paper in a set of three plats. That is on record now, here at the Auditor General's office. I also have another one of two pieces.

MR. SKEELS: There are certain cases where Auditor General's condemn that; the certificate has to be attached in certain cases.

MR. HODGMAN: In regard to the question of tapes, Mr. Mr. Rogers suggested that we might have a standard here at Lansing, and then all be alike. There is a difference in the quality of steel. A difference in the manufacture of steel causes a different rate of expansion in the different kinds of tape; and so two tapes might compare exactly at a certain temperature and when the temperature changed, the tapes would be different.

TOWNSHIP BURYING GROUNDS; PLATS AND RECORDS.

D. J. ALBERTSON.

Before I wrote my paper, I thought there was no question in regard to the statute, regarding plats, and I wrote to the Auditor General. He was of the opinion that cemetery plats came under the general plat law. That was news to me, and I took some pains to look the matter up. I consulted two different attorneys in the matter, and they did not agree with the Auditor General, but could not give a decided opinion. I went this afternoon and called on the Attorney General and thought perhaps I could get an opinion from him. He was very courteous and devoted some time to the consideration, but his duties were pressing, and he did not have time enough to devote to the question, but he was of the opinion that the law regarding cemetery plats and the general plat law were independent. He did not say that those which were made under the provision of the law in regard to cemetery plats would not be good, but he thought that the statute was deficient in some ways, and he thought that the diagram of the land and description ought to be more complete, so that the lots could be located without any question as to where they were. He suggested that it would be well to have the law amended so that the plat that was filed at the Register's office would be made of record, and a certified copy could be used in courts of record. He thought that cemetery plats, made under the general plat law, would be good, but he was inclined to the opinion that the fee of lands so transferred would be vested in the purchaser and not remain in the Board of Health. After this introduction I will read the paper:

Mr. President and Gentlemen:

It is not the object of this paper to offer anything strikingly original, or to revolutionize cemetery platting; but to simply present a few observations and plans that the writer has found adapted to the requirements of the work.

The time has come in many townships where the burying grounds located in an early day have become entirely occupied, and measures are necessary for their enlargement, or the location of new cemeteries. These old yards exist in all manner of form and condition. Many were never originally staked out; burials were made promiscuously, and so remain to this day; others, in years past, came under the supervision of officers with "progressive" ideas, who caused the trumpet to blow the resurrection signal for that particular yard, arranged the graves in rows, platted the ground with greater or less accuracy, perhaps terraced the lots and arranged things after the flower-bed style of architecture. Even at this late day, there seems to be little more system than in the past.

A brief digest of part of the law relating to township burying grounds may not be out of place:

"In every surveyed township, the board of health shall procure sufficient grounds for burial purposes, and their successors hold the fee of such land in trust for said township. They may sell or dispose of the same, or any part thereof, at any time until the same shall have been occupied, then only by order of court upon proper petition. In case of the division of a township, the cemetery belongs to that part in which it is situated. The board shall make all regulations necessary for the government of the same, and shall give notice of such regulations by publishing the same in some newspaper, if there be one in the township; if not, by posting the same in five public places. They shall keep the grounds properly fenced, and all cost incurred for purchasing, fencing and regulating shall be certified by them to the township board, as part of the contingent expenses of the township. They may convey single or family burial lots in such township burying ground to such persons as may desire to procure the same, and use the proceeds towards improving the grounds, but must certify the amount of such sales and expenditures to the township board. *But*, before they can sell or convey any lots as above mentioned, they must cause the burying ground to be laid out in such form as they may choose, and cause two maps thereof to be made under the supervision and direction of the health officer and clerk, which shall be certified by them to be correct. One of said duplicate maps shall be filed in the office of the register of deeds of the county, and the other in office of the clerk of the board.

"Said maps shall describe the lands belonging to such bury-

ing ground, its boundaries and location. Also, show the lots or sub-divisions named, or numbered, with their size, situation and extent. Also, the width, extent and location of all streets, alleys or walks."

To this I would add: Plant permanent monuments at all angles and at all intersections of principal lines, walks or drives; and, if practicable, give angles at intersection. Mark *all* dimensions of irregular lots, blocks or pieces, and give enough dimensions on those of uniform size to leave no uncertainty as to their size. Draw the map to a true scale, give unit of same, and show the meridian. In fact, make the diagram of land and description to conform with those intended for city and village lots.

No rules or suggestions can be given as to the laying out. Each case must be governed by circumstances. Township burying grounds, usually, being square or rectangular, and in size varying from two to six hundred feet, afford but little opportunity for fancy styles. If an addition, many times the layout of the original part prevents systems that would otherwise be desirable.

In the matter of stakes, there seems to be a commendable inclination towards permanent stakes at lot corners. Wood stakes are unsightly and of short duration. Probably the best are the vitrified fire clay or terra cotta stake with the numbers stamped into the material while plastic. Cast-iron stakes are durable, but those having the cross section of an I beam, to facilitate painting the numbers on the front, are liable, in a short time, to present a zig-zag line, very unpleasant to the eye. A ⊢ cross section might obviate this. The smaller sizes of drain tile, with but a few inches projecting above the surface, are, I think, the cheapest and most permanent procurable. By setting every tenth one of a larger size, no numbering is necessary.

The law provides that "The board of health shall cause the grounds to be laid out," etc. A certificate, something like the following would seem necessary, and show that they had done so, by what authority, under what conditions, and that they approved of the proceedings.

"*Know all Men by these Presents:* That we, the undersigned, constituting the board of health [or majority of] of the Township of A——, have caused the land embraced in the annexed plat to be surveyed, laid out and platted, in accordance with section 1638, chapter 39 of Howell's Statutes, 3d volume, the same to be used as a township burying ground and known as_____. We hereby dedicate said ground for burial purposes, subject to the existing regulations and such others as may be made for the government of the same. We also accept and adopt said plat as hereon delineated.

[Signed officially.]

_____, *Supervisor*,
_____, *Township Clerk*,
_____, *Justice of the Peace*,
_____, *Justice of the Peace*,
Board of Health."

The law further provides that "The plat shall be made under the supervision and direction of the health officer and clerk," etc. The following certificate, or its equivalent, would therefore seem imperative:

"We, the undersigned, B—— C——, as health officer, and D—— E——, as township clerk of the township of A——, hereby certify that the plat hereon delineated has been prepared under our supervision and direction, and that the same is a true map of said burying ground.

_____, *Health Officer*,
_____, *Township Clerk*.

Dated this_____day of_____189__"

The law provides that duplicate maps shall be filed in the office of the register of deeds of the county, and township clerk's office, etc. Some certificate like the following, on each, would seem essential, and show that the other map had been filed as required.

"I hereby certify that a duplicate copy of this map of_____ as compared by me, has been filed in my office.

[*Signed*]_____"

A surveyor's certificate, something like the following, might be advisable, and show who made the survey, nature of permanent monuments, etc.:

"I hereby certify that the plat hereon delineated is a correct one, and that permanent monuments, consisting of (*State nature, size, material, etc.*), have been planted at points marked thus O, as hereon shown, at all angles in boundaries, and at all intersections of principal lines, walks or drives.

----------, *Surveyor.*"

It would be well to add, for the convenience of the recorders:

"Received and filed in my office at_____o'clock____M., this _____day of_____, 189__.

[*Signed by register of deeds or clerk.*]"

This closes the plat or record and location of lots, but affords no means of showing location of graves, or names of those interred. This is one of the most important parts of a cemetery record. It takes but a few short years for a grave to sink to the level of the surrounding surface. Quite recently a case came to the knowledge of the writer where a grave dug on supposed unoccupied territory unearthed the bones of a previous burial. There is, also, an inclination towards discarding raised mounds over the graves entirely.

One of the best records that has come to my knowledge is shown below, and comprises the desirable features of several records:

Burial Record of Evergreenwood Cemetery:

Date of Burial.			Full Name.	Male or Female.	Age.	No. of of Grave.	Place of Death.	Disease or Cause.	No. of Lot.	Remarks.
Mo.	Da.	Yr.								

In the column "No. of Grave" is inserted the number consecutive with the digging, reference being had to a diagram of the lot, not drawn to scale, for their relative positions, thus:

	3	1		2	4

or by dividing each lot into sections of an arbitrary size, and numbering them consecutively, thus:

1	2	3	4
8	7	6	5

giving to each grave the number of its section. This I would amend by giving to each grave the number corresponding to the number of feet the center line of grave was from a certain uniform point on each lot, as the right hand front corner, designating front and back tiers on square lots. The above meets most requirements of a *burial* record, but nothing further.

The following I have designed as embracing nearly everything required by way of reference or record.

EAST COOPER CEMETERY.

LOT No.----------

Conveyed to----------

Date----------

by----------

----------*Sexton.*

Heir's burial privileges acquired by

----------*heir of*----------

by----------.

----------*Sexton.*

———

----------*heir of*----------

by----------.

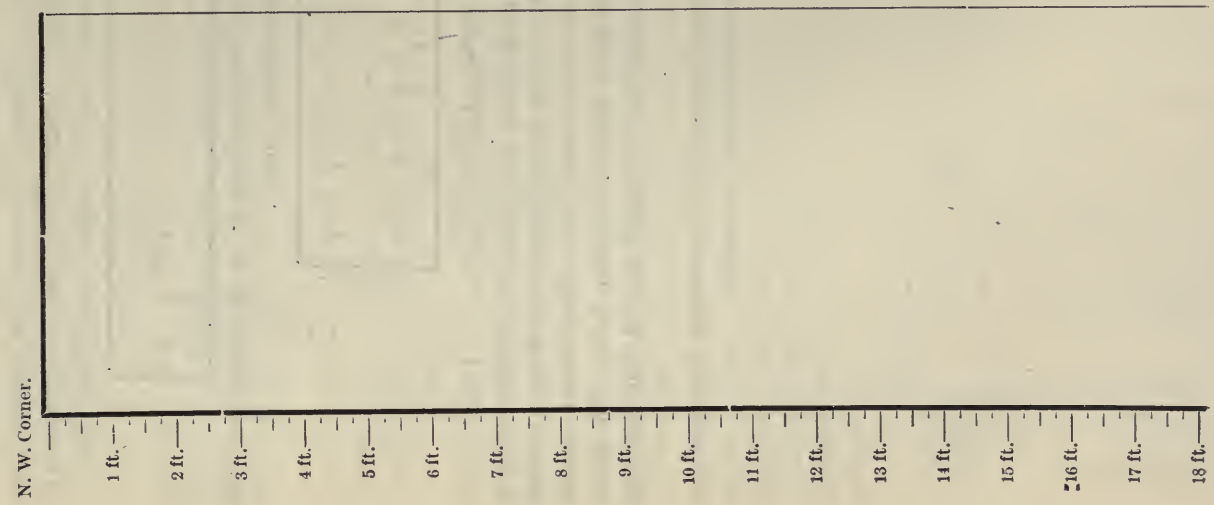
----------*Sexton.*

———

I hereby surrender to the township the unused----------*of Lot No.*---

---

For further record of this Lot see----



The blank represents one page of the record book as it leaves the bindery, and space for the record of one lot. The size of page being variable, to correspond with the size and shape of lots.

The first column should show the number of lot; name of person whom it is "conveyed to;" "date title was acquired;" how it was acquired, whether "by certificate from board of health," "stipulation with sexton," or otherwise, followed by signature of sexton.

After the death of the owner, the second column would show in whom the privileges become vested, and how; whether "as legatee," by "stipulation among heirs," "only heir," etc., followed by signature of sexton, cognizant of facts.

The third column shows in case an owner had used only a part of a lot, and by reason of removal, or other cause, wishes to return to the township the unused part, he could do so by filling out and signing the blank given; though, in some cases, it might be advisable to have a more formal document additional. The second blank could show where record of any surrendered part would be found. Where any certificate or deed was recorded. Where any record of action of board of health regarding lot, would be found, etc.

The scale marks the front of the diagram of a lot, the O being some uniform point on all lots. The co-ordinates of each of which if practicable, should be given. The remaining lines of lot need not be drawn to scale, but exaggerated, to give room for names. The dimensions might well be marked on them. Supposing a grave to be dug at some point on a lot designated by the owner. Measure on the ground along the front of the lot the distance from O (in this case the N. W. corner) to the center line of the grave. At the corresponding distance on scale at front of lot, on record page right across the lot, name of person buried, age and date of burial. When a monument is erected, it can be designated by a □ at head of grave.

There is also connected with the book two indexes; the first, containing the names of lot owners, and number of their respective lots. The second (large) the names of all persons

buried, year buried, number of lot on which they are buried and remarks, thus:

Year Buried.	Full Name.	No. of Lot.	Remarks.

The column "year buried" will be found very convenient for sextons in making out returns of burials each year.

Then, if we know the name of a person previously buried, by referring to the index of burials, the number of the lot will be shown; by turning to the lot, the scale at front locates at a glance the exact position on the lot, while the plat will locate the lot.

It would be well also, to have blank record pages in the book for entering the regulations governing the yard and the amendments thereto. Also that the sexton be provided with copy of the plat.

It would be desirable to have two copies of the record books; one in the sexton's office, and one in the township clerk's office, the same to be posted once each year, to prevent loss of records by fire or other cause.

The President: The gentleman has presented this grave subject very fully. The system of record is about as good as anything I have ever seen.

Mr. Appleton: It is just what is used in this city. It was an old sexton who originated it. We staked out the cemetery. He, caring for it so long, had found out just about what was wanted.

The President: I should think it would be still more necessary under the system of modern cemeteries, where, as soon as possible, they level the graves down and cover them over with sod, so that the whole surface of the cemetery is a smooth surface.

Mr. Appleton: That is not done here, but it adds very much to the appearance.

REPORT OF SPECIAL COMMITTEE ON STATE BOUNDARY.

To the Michigan Engineering Society:

Your committee would respectfully report:—

This society has more than once had evidence to show conclusively that our surveyors along the southern boundary of the state have difficulty in establishing this line, or leave it unmarked. This arises from its complications as a state boundary, and also from its extinguishment. The meager field notes and poor plats, which your committee has carefully gone over, give no more certain and permanent monuments across from Lake Erie to Lake Michigan than witness trees, some being aspen, birch and maple, none better than the section lines in any part of the state.

The line adopted was run by Wm. Harris in 1817, and, along the state of Indiana, was retraced in 1827 by E. P. Kendricks. I quote from his notes to show the character of the monuments:

"October, 1827. Commenced at the southern extremity of Lake Michigan, at a corner established by Mr. Harris in June, 1817, which has its bearings as follows: An aspen 9 S, 56° W, 200 lks. and an aspen 12 S, 42° E, 184 lks. The post which was set by Mr. Harris was entirely covered by the sand. I traced his line east to his 1st and 2d mile corners and found them correct. I then traversed the margin of the lake to get 10 miles northing (here the courses and distances are inserted) which brings me 32 lks. too far north. Thence south 32 lks. on beach to commencement of the line between Indiana and Michigan. The lake coast, so far as I traversed, is a continual chain of hills formed of beautiful white sand, in most places very high, and little or no vegetation. Back of these sand hills it is generally swamp and marsh, therefore there are but few places that the lake can be approached without difficulty and no harbors or islands are to be seen. From commencement of low water mark, ran east 250 ch. to a pine 10 in. in

diameter, on top of first bank, which I marked, on north side, M. L., and on the south side I. L., from which," etc., etc.

These are specimens of the monumenting of our state boundary. No wonder, then, that citizens of one state claim to reside in the other when the tax-gatherer comes, and that criminals raise the question of jurisdiction. No wonder that highways, school districts and farm lines have become uncertain. I might also say that the Ohio boundary, although retraced by Mullett as late as 1842, is no better monumented, and that our sister state is giving the subject attention.

The Michigan legislature of 1889, by concurrent resolution No. 10:

Resolved by the Senate (the House concurring), That the secretary of the Interior be and he is hereby requested to cause a survey of the boundary line between the state of Michigan and the state of Ohio, and between the state of Michigan and the state of Indiana, to be made, and to make such arrangements for the preservation of the monuments of such survey as will secure the endurance of the same for the future.

And further resolved, That a duly certified copy of this resolution be transmitted by mail to the secretary of the interior by the governor of the state at the earliest possible moment.

Whether this urgent appeal to the secretary of the interior has caused that official to start out with his compass and Jacob's staff, your committee has not learned. It is a beginning.

In our opinion this case does not need the intervention of congress. The states interested are abundantly prepared to act; only put them into step. It does not call for fine-haired surveys on thirty-second instruments. It is a case where good, keen-eyed, level-headed engineers shall go out and take evidence of what they find and make a note of it with a proper report, and then be authorized to fix that evidence both of record and upon the ground for the many years to come.

In 1878 the state of Ohio passed an act of a similar intent.

"Be it enacted," etc., "That, as soon as practicable after the passage of this act it shall be the duty of the governor to appoint three competent persons to be commissioned to act

in conjunction with a similar commission of the state of Pennsylvania (but not otherwise) to examine as to the true location of the monuments which make the boundary line between the state of Ohio and the state of Pennsylvania, and, in connection with the said commission of the said state of Pennsylvania to replace any monuments that have been removed, or that have become displaced or dilapidated on the boundary line of said states. Said commission shall report to the governor an account of all expenditures arising under this act, together with a full report of their proceedings, accompanied by such maps and draughts as may be necessary to a clear understanding of the same, and the governor shall report the same at the first meeting of the general assembly thereafter." Severe penalties were enacted for the disturbance of the monuments set by the commission.

Then, in 1879, an act was passed to give the commissioners authority to erect these monuments. Also, in 1883, a joint resolution was adopted referring to the work done by the commission, as a resurvey and a remarking of the boundary.

"*Therefore, resolved*," *etc.*, "That said boundary line, as marked by said commission and set forth in their report, field notes and map, is hereby accepted by the state of Ohio as the true boundary line between the state of Ohio and the state of Pennsylvania, the auditor to carefully preserve the report of the commission, field notes, maps, etc."

This brings us to the same conclusion as heretofore, namely: If this plan was good enough for Ohio and Pennsylvania, it is good enough for Michigan and the states bordering, and should be carried out as soon as may be. It is a mortifying admission that our own state land office is not furnished with better data of this boundary. A few torn plats and copies of abbreviated notes, referring to perishable witnesses, is the outfit. Your committee considers it important that this society, which is well qualified to know the facts, should ask our legislature to take immediate action on this question, and invite our sister states to co-operate with us.

Respectfully,

GEO. E. STEELE, *Chairman.*

THE PRESIDENT: What shall we do with this report?

MR. HODGMAN: I move that the report be accepted, Motion seconded and sustained. Report accepted.

MR. HODGMAN: I would further move that the committee be requested to prepare a suitable memorial to the legislature, to be presented in the name of this society, to report sometime during the meeting of the present convention. Motion supported and carried.

MR. HODGMAN: Some one of our members at a former meeting, I think it was Mr. H. C. Pearsons, at any rate, someone familiar with the work of retracing the line between Ohio and Pennsylvania made the statement that in retracing that line, the best preserved monuments they had were wooden stakes. The stakes outlasted the stone monuments that had been built with great care.

The following memorial was prepared by the committee and approved by the society:

MEMORIAL.

To the Honorable, the Legislature of the State of Michigan:

Your petitioners are members of the Michigan Engineering Society and would respectfully represent:

That, we have, through a committee appointed two years ago, made investigations as to the condition of the *State boundary* between the states of Michigan and Ohio, and the states of Michigan and Indiana, a report of which committee is subjoined.

In view of the importance of the subject, in the settlement of the various questions constantly arising, and of the proper perpetuation of these boundary lines, we would ask that immediate attention be given to the subject by the enactment of a bill, by which the Governor will be authorized to appoint a commission of three members, to co-operate with a similar commission from each of the states interested. First, to

report on the exact condition of said lines; and second, to properly perpetuate them.

E. W. Muenscher,
D. Skeels,
Wm. Appleton,
Wm. B. Sears,
H. F. Bean,
F. H. Williams,
A. L. Marhoff,
E. W. Redman,
F. F. Rogers,
Wm. G. Fargo,
Dan. J. Albertson,
John J. Granville,
Geo. W. Doane,
O. C. Goodale,
M. H. Bailey, Eaton Co.
Sam'l E. Jones,
H. L. Thayer,
H. E. Riggs,
A. J. Teed,
E. O. Sellers,
F. Hodgman,
Geo. E. Steele,
Frederic L. Church.

ADDRESS OF MAYOR BEMENT.

Mr. President, and Civil Engineers of Michigan:

One of the pleasing and innocent occupations of the Mayor of this city is to welcome to its borders various bodies of men who come here to hold their annual meetings, and I assure you it is a great pleasure to welcome you here to-day.

Now it is customary on an occasion of this kind to remark, and I will say that I have made this same remark a number of times, that you are certainly a fine looking body of men. It is not necessary for me to say that I am highly pleased with your appearance.

I think perhaps that I may have a slight conception of what is expected to-day of a Civil Engineer in Michigan. I only have a slight conception, but I have wished a good many times, since occupying my present position, that the Civil Engineers of Michigan, and particularly those of Lansing, might have had at least one hundred years experience. The building of a city I do not know very much about, but I do know that beginnings and small things oftentimes do grow into large things, and the desirability that somebody should know at

the beginning what they are going to grow into. If that were possible, I know that we should have saved a great many mistakes, and a great deal of useless expenditure of money. I have sometimes thought that even in the smallest villages if they should employ a competent civil engineer, when it was simply a village, and should pay that man a good salary, that the amount he might be able to save to that village corporation would more than compensate for the salary.

How much more is this true of our larger cities. How much more it is true that a man who is taking charge of the work of building a city, should be thoroughly equipped for his work. Most people have to be trained to their occupations, and I can readily see what a task you all have before you in equipping yourselves for the work which you are expected to do.

Therefore gentlemen, I take especial pleasure to-day, in welcoming you to Lansing, and saying to you that I believe that not only our city government, but that our citizens generally appreciate the position you occupy in the industrial progress of the country in laying out our cities, in making them beautiful, in furnishing them with good sewerage and good streets, and all those things which go to make up a fine city, of which I think no state has more, than our beloved Michigan, and I have no doubt that it is very much owing to your efforts that such is the case to-day.

I therefore say to you, gentlemen, you are welcome to Lansing, and I take pleasure in handing you the keys of the city and saying "come in and take possession of it."

THE PRESIDENT: In behalf of the society, I beg to return our thanks for your cordial greeting. I am only sorry that the engineers are never speakers. But perhaps the best reply I can make to your welcome is to assure you that it will not be necessary to increase your police force on our account, while we are present with you.

GOOD ROADS.

BY E. W. MUENSCHER.

[Chief Engineer M. & G. R. Railroad.]

In opening the discussion of the subject of "good roads," I think I can truthfully say that there has never been a time in the history of this country when there was so general and deep an interest in this subject as there is to-day. Much of this interest is due to the efforts of the League of American Wheelmen, whose publications have been widely circulated, and have been instrumental in diffusing much information among the masses of the people. They have also been the means of awakening the interest of the press of the country, and we engineers and surveyors are now receiving a large amount of gratuitous instruction in the art of road building from the omniscient editor. It is presumably intended for others less fortunate than ourselves, but there is no law which forbids us too from drinking at this perennial fountain of wisdom, and often perhaps with profit.

But the American people are apt to run to extremes, and while there is much that is being written and said that is wise and just and timely, there is also much that is unreasonable in the complaints and criticisms which we sometimes hear from the more zealous advocates of road improvement. While we are free to admit that the roads of the state of Michigan are far from being what they ought to be for the best interest of the state, and that it would be difficult to exaggerate the wretchedness of their condition at some seasons of the year, we should not forget that the state is not yet 55 years of age, and that over a large part of her territory still waves the primitive forest. Her first settlers were poor men who came with but little capital beyond their stout hearts and willing hands, to subdue an unbroken wilderness. Their lives were spent in the hard toil of clearing off the timber, pulling out the stumps and breaking up the virgin soil. They had no time, nor means to devote to road-making, beyond the simple wagon track over

which they hauled their scanty crops to the nearest market. The accumulated fruits of their toil, and that of their children, have been absorbed in the construction of homes and out-buildings and fences, and churches and school-houses. These were the prime necessities of a civilized and christian people, and until they were provided other things which seemed to be less essential were obliged to wait their turn.

It has been a work of years, and while it was going on but little could be done in the way of road construction beyond what absolute necessity required. Over the greater part of the state this work is still going on, or is not yet begun, and yet we are reproached because our roads, built as they have been solely by voluntary contributions from the hard earned savings of a free people, do not always compare favorably with those of Europe, which have been the gradual growth of centuries of civilization, and too often the product of enforced or enslaved labor.

Twenty-two hundred years ago the Romans were building roads almost as solid and enduring as the eternal hills from which the rock was taken to pave them. Eighteen centuries ago Pliny was writing specifications for road construction, which would not be bad at the present day, and which read marvellously like the strictly original productions of some of our modern engineers. Nine centuries ago the wandering follower of the Prophet could travel ten miles in a straight line along the paved streets of the Moorish city of Cordova by the light of street lamps. The paving of the streets of Paris was commenced 700 years ago, and of London but little later. The most ancient of these works survived for use and example and instruction, even through the ages of darkness and ignorance, and superstition, mud and filth that spread like a pall over Europe, and since the invention of printing, and the dawning light of religious freedom began to lift the cloud, more than 350 years have elapsed, (seven times the life-time of the state of Michigan,) through which inch by inch could be added to the relics of long past industry and wisdom. Give Michigan three centuries more of life, and she will show you roads all over her vast territory, over which even a Roman Censor or a Saracen Caliph need not scorn to ride.

But, however reasonable this excuse may be for past deficiencies, and however justly it may still be urged for a large portion of our state, there are many other portions to which it will no longer apply. There are whole counties in the southern part of the state, and many townships and neighborhoods elsewhere, in which the laborious pioneer work of clearing off the forests is largely completed, churches and school houses are provided, surplus capital is beginning to accumulate, and the time has come when it is possible, in these sections at least, to begin the work of building good roads.

What, then, is required to start the good work? The reply is: 1st, Education; 2d, Legislation; 3d, Action. Many of us perhaps would like to skip over the first two stages and begin with the third. In a despotism this would be possible, but under a popular government like ours, never.

Roads cannot be built without money; money cannot be raised without taxation; taxation cannot be levied without legislation; and no legislation could be of any permanent avail unless demanded and sustained by public sentiment. To create this sentiment is the first necessity of the hour. The people of the state must be convinced, 1st, that improved roads are good things and, 2d, that they can afford to put their hands in their pockets to pay for them. So far as the first of these two points is concerned, but little remains to be done. There is not one man in ten in the state of Michigan who does not know that good roads would be a blessing to himself and the whole community. We read a great deal just now about the necessity of educating the farmer, but, as I believe, without good reason. The farmers of Michigan are, as a general thing, an intelligent and wide-awake set of men. Though, as a class, they may not be able to figure out, in dollars and cents, the precise annual loss which they sustain by reason of bad roads, or to apply the most efficient remedy, they are generally very thoroughly convinced that good ones would be a great boon to them. Indeed, I am inclined to think that no class of men is more fully aroused to the necessity of road improvement than the farmers. They know that first-class roads mean to them the ability to go to market at

any time in the year; to take advantage of the best prices and the best markets, and to put the difference in their pockets; to haul double the load in half the time, and thus save a large amount of labor and time, to be applied, with profit, to their farms; to get along with fewer horses and save in purchase price and cost of keeping; to introduce a more varied and profitable husbandry by cultivating garden truck and other perishable produce instead of the low-priced grains to which they are now confined. They know, too, what is of even greater consequence than mere pecuniary profit,—that good solid roads mean the breaking of the blockade of mud which now shuts them and their families up in their houses during much of the year. They mean the ability to attend their churches and farmers' clubs and social gatherings, or to visit a neighbor, or to go to town to a concert or lecture whenever they feel like it. They mean daily mails and free delivery, and larger school districts, and better teachers, and better graded schools, from which their children will not be kept away one-fourth of the time by the depth of the mud. They mean all those intellectual and social enjoyments, the absence of which is the crowning evil of rural life, and, more than anything else, is driving so many of the farmer's sons and daughters to the cities, and so many of their wives to the asylum or the grave.

Why, then, do we not have good roads? Mainly because the farmers know that, under our present road system, the entire cost of these roads would fall upon them, and it is a burden which they are neither able nor willing to bear. The wheelmen, the merchants, the residents of cities, the railroad companies, would all share largely in the benefits of good roads, but would contribute nothing toward paying for them. Until this obstacle is removed we need not look for improved roads, and all our arguments and demonstrations will be in vain. This can only be done by legislation, and it is to our own state legislature that we in Michigan must look for relief.

It is true that some are advocating the adoption of a general system of road improvement by the general government, and it has even been proposed to create a new department with a cabinet minister and a few score of clerks to tell

us how to build a road, but it is not at all likely that any such project will succeed. The general government is likely to have its hands full for years to come in discharging its own legitimate functions without assuming those of the states, and if it will only keep our rivers and harbors in shape to accommodate our commerce, we ought to be content.

The commissioners appointed by Gov. Winans to investigate this subject have reported that, under the provisions of our state constitution, the necessary legislation cannot be obtained, but this need not discourage us from considering what this legislation ought to be, for there should be no doubt that, in the present condition of public opinion, our legislature will promptly submit, and the people as promptly ratify, any necessary amendment.

As to the details of the required legislation, there will be much difference of opinion and much need of wise counsels. Especially will it be necessary to avoid running into extremes, either as to the amount of work to be done or the material to be employed. Great as is the evil of bad roads, that of excessive taxation or of crushing debt might be still greater. Whatever is done must be limited by the ability of the people of the state to pay for it without distress. Upon one point there will doubtless be a very general agreement, and that is that the present system, both of raising and expending the road funds of the state, should be abandoned. One of our most intelligent farmers, in an article in the *Grange Visitor*, of December 1, 1892, which is well worth reading, estimates the the total amount raised annually in the state for road purposes at a little more than $2,000,000 in money or its equivalent, and that not less than half of this sum is wasted on the wages of useless officials and on inefficient, misapplied and misdirected labor. All of us who have ever seen the average highway commissioner and his neighbors working out their road tax by scraping the sods and silt from the sides of the road into the center, or have ever had occasion to examine the average highway bridge, will readily agree that this estimate is not far out of the way. But, even if the entire amount were wisely expended, it would be far below what is necessary. Accord-

ing to the 11th census the land area of the state of Michigan is 57,430 square miles, or about 1,600 ordinary townships six miles square. This would give each township, on an average, $1,250 a year. Deducting the necessary cost of repairs, superintendence and administration, there would not be enough left to build half a mile of reasonably good road. The first mile built would be worn out long before the last one was begun. We must certainly have more money, but how to raise it without imposing too heavy a burden upon the people will be the most difficult question for the legislature to answer. It concerns us rather as citizens and taxpayers than as engineers, but it must be answered satisfactorily before the engineering question can come up at all.

It will not be far out of the way to assume that in each ordinary township there is now, or will be eventually, about seventy-five miles of highway. Estimating the average cost of a good gravel or other improved road at $2,000 per mile, the entire cost to the township would be $150,000, or about $6.50 for each acre of land in the township, and $520 for each 80-acre farm. It is safe to say that there is not a township in the state that either would or could attempt to raise this amount in a single year, or even a short term of years. It would be equally unwise for any township to load itself with such a burden of debt for the purpose of completing the work at once. It is plain that the work of construction should be spread over a series of years, and the work of payment over a still longer period. All the benefits of good roads will descend to our posterity, and there would be no injustice in asking them to pay part of the cost. Suppose each well-settled township should undertake to build its system of roads in, say, ten years, beginning with those running each way from its railroad station or principal market town, and pay for the same partly by an annual road tax, somewhat larger than the present one, and all paid in cash, and partly by bonds running from ten to thirty years, so divided that the payments each year should be approximately equal. The burden would thus be distributed over forty years, and would not be severely felt, while the benefits would be realized within a very reasonable time.

It might be advisable to assess part of the cost of each road upon the district immediately benefited, as is now done in some states, and is very common in our Michigan cities in the case of street improvements. But, even if this policy should be adopted, a part of the amount should be raised by general tax upon all the property of the township or county, so that all who are to enjoy the benefits may help to bear the burden. How far the state at large may share in this work, beyond providing the necessary legislation is a disputed and delicate question. My own judgment is, that in view of the unsavory odor of fraud and favoritism and extravagance, which has attached to most of the past efforts of the state to carry on internal improvements, it would be the wisest policy for her to keep her hands off entirely. She should, however, guard against unwise parsimony on the part of local authorities by prescribing standards of construction, to which all improved roads must conform, just as she now does in the case of toll-roads. She might also very properly aid the work by the carefully guarded loan of her credit. Our state is practically out of debt, her credit is very high, and her indorsement upon county or township bonds issued in judicious amounts for road construction would enable them to be sold readily at par, at low rates of interest. The burden upon the people would thus be largely diminished, while the state, being only an indorser and having the supreme power of taxation for the security, would be perfectly safe.

She could also aid indirectly by legislation, encouraging the use of wagon tires wide enough to pack down an improved road after it is built, instead of cutting it into ruts, as is now common.

But whatever means may be employed for raising money for the construction of a system of improved roads, success cannot be expected, unless the work is done under the supervision of competent men. And here there will be need of much caution. The fact that a man has received a majority of the votes in a county for the office of county surveyor, in a heated political contest, in which all personal qualities are often lost sight of in the struggle of two great parties for

supremacy, is no criterion at all of his fitness for this duty. Under our present laws, there is nothing to prevent a man from being so elected, who does not know the difference between the jacob-staff and the needle of his compass, and even if he were most thoroughly qualified for the ordinary duties of a county surveyor, it does not at all follow that he would be a competent road builder. A man may be an excellent land surveyor and yet know little or nothing of road making, or any other branch of engineering construction. For this reason it would be very unwise for the legislature to attach the duties of a road superintendent to the office of county surveyor by force of law. At the same time his public and official position, his presumed knowledge of the use of instruments, and his affiliation with the political party in control in his county, would naturally commend him for appointment to the charge of the road work of the county if he possessed the other necessary qualifications, and this fact should be an inducement to those who now fill that office to acquire those qualifications, and might possibly lead in the future to bringing a higher order of talent and acquirements into an office which now has but few attractions, and very generally goes begging. What these qualifications should be, and how they should be tested, it must be the duty of the legislature to prescribe, and the best interests of the people of the state require that the duty should be carefully performed. If no test at all should be required, the probabilities are, that in very many localities, motives of economy or of personal or political favor would lead to the appointment of men poorly if at all qualified for the work. Some test should be essential, and I know of none better than the certificate of a competent and honest Board of Examiners, and that board might well be composed ex-officio of the professors of engineering and surveying in our State University and Agricultural College. They are men who have been appointed to their positions by reason of their high attainments in the branches of knowledge with which a superintendent of roads should be familiar; they are specially qualified by their long experience as teachers for finding out just what a man really knows; they are happily free from the restraints

and prejudices and temptations which might affect the action of a local or political board, and their being already in the employ of the state would considerably diminish the cost of their work.

In many of our counties there would be no difficulty in finding more than one man who either is already qualified or could easily make himself so by the study of the many excellent treatises on road making which are now in the market, but in others, it might be more difficult to find material, and for their benefit it would be policy for the state to provide a special course of instruction in road location and construction in the University or Agricultural College, or both, during the winter months when those for whose benefit it is intended could most readily attend. The only expense would be for the necessary additional instructors.

If in addition to this provision the state would publish in cheap form, and distribute to all the supervisors and county officials of the state a compact treatise on the construction, improvement, care and repair of common roads, including those of gravel and broken stone, together with approved general specifications, it would be of really more interest and value to the people of the state than a majority of the reports which it now issues.

It is not my intention on this occasion to say anything on the engineering features of this subject. I hope to hear this better done by others. I will venture, however, to touch briefly on one other point in which many members of this society may well take an interest. No interest in the state of Michigan would be more benefited by good roads than the railroads. During a large part of the year much of their rolling stock is lying idle because farmers cannot bring their produce to the station. At other times they cannot get cars enough to haul away this produce, and sidings and elevators and warehouses are gorged to overflowing; extra train forces must be employed; men in other lines of traffic who need cars are denied, and general disturbance of business, delay and loss follow. Good roads would distribute this business more uniformly over the year, to the mutual advantage of the com-

panies and their patrons, to say nothing of the increase of population and production and prosperity which would follow. These railroad companies are usually very earnest advocates of good roads, but, under the laws of this state, they do not contribute one dollar toward their construction. This is an injustice which ought to be remedied if possible, but, whether it ever is or not, there is one way in which the railroads might greatly help on and hasten the good work without cost to themselves. If we are ever to have anything better than dirt roads in Michigan, we have got to depend almost entirely upon gravel. This material is found in vast quantities in the drift which covers the entire lower peninsula, but the deposits are local, and there are large sections in which a stone as large as a hazel-nut would be a curiosity. The cost of hauling gravel to such localities is so great as to forbid its use. It is here that the railroads could do a good work. Most of them pass through or near large gravel beds. If, at times, when many of their flat cars are lying idle, they would load them with gravel and deliver it at each station along their lines at bare cost, to be used in building gravel roads each way from those stations, they would greatly diminish this most serious obstacle. Some of them also own steam excavators, which, at times, could be used in loading the cars, with a further saving in cost; and other roads might well afford to purchase these excavators for this purpose. It might even be policy for each road to keep on hand a few miles of light rails and ties to be laid down temporarily along these highways, over which the gravel cars could be hauled, and unloaded by machinery, with another considerable saving. This idea is not a new one, for it has been put into practice, to some extent, by some of the roads in Indiana and Illinois, with good results to themselves and the country through which they run. The roads of Michigan might well follow the example, and if the members of this society who are connected with them would use their influence with their superior officers, to induce them to try the experiment, they might accomplish much toward hastening the day to which we all hopefully look forward.

EAST PARIS, January 17, 1893.

E. W. Muenscher, President Michigan Engineering Society:

DEAR SIR: I regret that I have been unable to prepare a paper on the subject of roads, as requested, for your meeting. What the farmer wants now is laws that will compel all property and all people to pay its and their full share of the expense in making good roads, and a knowledge of the probable cost of such roads. The farmers have given all the land for the public roads, and, since the settlement of the country, have paid all the taxes for road improvement. The public have had the use of the roads, and only part of the public—the farmers—have borne any of the burden of making them. There has been no law by which they could avail themselves of the skill of the engineer or surveyor, consequently all roads have been made by guess. One-half the labor and money expended for the last fifty years, had it been expended under the direction of competent engineers, would have given us infinitely better roads than we have to-day, and the foundation would have been laid for much better roads than we can now make, unless at greater expense than if we had started right. Without the aid of the engineer we never need look for good roads. Men do not build houses or public buildings without first consulting the carpenter or architect, nor do they engage in an important lawsuit without consulting a competent lawyer. I would suggest that your meeting give to the public an estimate of the probable cost of good roads, to be built by contract, under the superintendence of proper commissioners and engineers. A first-class road is better than our present "toll road." It is not expected that we will at once enter upon a system of road improvement and make finished roads equal to those in the "Old Country," but we can make a good beginning, and, in time, make complete finish. Your members, coming from all parts of the state, will have some knowledge of the available material for making the roads. Give an estimate of the cost of preparing stone by machinery, for stone roads; the amount required for the

ordinary travelled roads; the cost of a stone road as compared with gravel roads, where the material of the one is as accessible as the other; the cost per cubic yard of crushing the stone found commonly on the farms of the state; the thickness of stone required for a stone road, and the thickness of gravel for a gravel road. The farmer wants good roads and must have them before he can enjoy rural life as he should. When we get good roads we shall get free delivery of our mails. Good roads and the free delivery of our mails will both come at the same time. When we get both, farm property will have greater value, and rural life will be more attractive and enjoyable. I think the more intelligent public, if not all the people, will give thanks for whatever information and advice your intelligent body of engineers may see fit to give. Prejudice will exist for a time, but will soon give way under the second sober thought of the people. I shall look for good results from your meeting. Truly yours,

S. S. Bailey.

IMPROVEMENT OF COMMON HIGHWAYS.

BY R. C. CARPENTER, ITHACA, N. Y.

As many members of the society no doubt remember, the writer has discussed the question of Road Improvement, by lectures, and by articles which have been published in the Reports of the state Board of Agriculture. The effect produced by these articles have seemed quite insignificant, and a more extended experience has led me to believe that the question of road improvement is to be first discussed as a social and political question, rather than as an engineering one. There is little use in giving information regarding the construction of roads, unless a desire can first be kindled for better roads. The people should be taught that better roads will pay, that it is poor economy to waste time and animal power in dragging light loads over muddy roads. If they can see that good roads pay, then they may be induced to build good roads. The present movement is the first that has been

started that has had any chance of success, and this is due to the fact that the movement has been conducted in a manner to appeal to the pride and interests of the people. It is the duty of every engineer to press onward with enthusiam and urge in every possible manner the success of the movement. This should be done from the standpoint of the citizen, and not from that of the man who sees in the success of the proposed movement, a job in the distant horizon. Indeed, such advocacy will imperil the success.

When the people have been led to the idea of road improvement, then will they listen to technical methods and plans of securing such improvement. To-day the question is more of a political one, and the attention should be given principally to the ways and means of securing public interest and public attention.

While it is certain that there is no public investment that will return so much to the rural population as that put into road investment, still the fact must be faced, "that good roads will cost money," and the people are not accustomed to put good money on the roads.

You will find also that in your state the wheels of progress are blocked to a great extent by your existing road laws.

I do not refer here to the system of paying the road tax in labor, which has so long prevailed in nearly every portion of the country, but I do refer to the senseless method of dividing up townships into districts for road improvement. The payment of the road tax in labor, is in my opinion, not the bar to improvement that so many have claimed, and considering the small amount annually expended, I believe as much has been accomplished as could have been done with cash. It is true that the labor has often been badly directed, and the improvement which resulted of a negative character, but I think no one believes that the same talent that so lavishly wasted and misdirected labor would have done any better with money. The remedy is not to be sought primarily in a money tax; no tax can be used to benefit the highways, until the law permits a combination, of all the parties interested in road improvement of a partial highway. The present system divides the country in sections of small extent, with some main road, and

a great deal of back road. It often happens that the men who work the road and pay for the improvements, rarely travel over it, and have no personal interest in the road at all. Again the system does not admit of different trial improvements, each land owner secures about the same expenditure to the road adjoining his premises, whether the road is of importance or not. The expenditure of the labor or money with such a system is attended with diffculties which will surely defeat the object sought.

A township district, since it is larger, might in some respects, be an improvement, but even here we should find a want of interest, or perhaps a clashing of interests that would defeat the best laid plans. The true road district is one formed on natural laws, and by a community of interest of those who use a given highway, and is made regardless of township or even county lines.

It is no doubt practicable to provide that a certain district interested in the improvement of a given highway can combine, and organize to improve that highway by taxation of all the property benefited. Such a law would result in the construction of trunk line roads leading in various ways from the principal market towns, which would in this way afford with moderate cost, the benefit sought in the proposed improvement.

It would also result in the construction of cross roads or by-roads, branching at intervals, as the people require, from the more substantial and better built main roads. The latter system could be organized as independent of the present system, and a money tax could be raised for the principal highway, which in such a case should be released from the supervision of the present authorties.

The above system is urged because the writer believes, first, that it is practicable; secondly, that it will impose less hardship upon those who are interested; thirdly, that it will result in producing the desired improvement with less cost than any other plan of organization. It will be less costly, for the reason that the district improvement is on a sufficient scale to provide good engineering talent, and good supervision; fourthly, it will meet with less opposition since it permits the

organization of people with a common interest, and provides for the distribution of the cost among all those benefited.

What may seem as a model of the method proposed has already been tried with success as applied to public drainage, and this has resulted in much good, and serves to indicate that such a scheme is feasable and will be successful.

THE NEW ROAD LAW.

BY SETH DEAN, GLENWOOD, IOWA.

What shall the new road law be? This is the question that both engineers and taxpayers are asking at this time in a great many of the states of the union; and, truly, it is a much easier question to ask than to answer, for past experience warns us that, unless we can provide a better law in all respects than the one we have, the public will be the loser by the change. The first consideration of law-makers should be to so frame the law that the greatest benefit may be realized by the public for the least expenditure of money, not only in the first cost of the work, but in the annual cost of maintenance after the work has been constructed, as well. With this view the writer offers the following plan as his idea of the proper solution of the problem:

For the convenience of officers who have charge of the construction and repair of roads under the plan presented, they should be divided into four classes, as follows:

Class No. 1 should include all roads which now are, or are destined in the near future to be, main thoroughfares of travel. These are usually the direct routes between cities or business centers of the country. These roads, if not already established on the most economical route, all things considered, should be revised and, after a thorough examination of the country, be placed on the best ground, and then be made of proper width and grade to accommodate the travel, and the surface paved with brick or covered with some other material suited to the climate and conditions of travel.

Class No. 2 should include the principal routes of travel between the smaller cities or the principal towns. The

location of these roads should be made with the same care that those of the first class are, with respect to alignment and grade, and should be covered with some suitable material, not necessarily as heavy or expensive as that on No. 1, but suited to the conditions of the case.

Class No. 3 should include the principal country roads, usually those leading into the market towns or cities from the country. These roads should be located as much with reference to the accommodation of numbers of the people who will use them, as to the sole matter of grade, but they ought not to be diverted from their general direction to accommodate one or two parties. This class of roads, too, should be well drained, and, if circumstances will permit, may be covered with gravel or some other suitable material.

Class No. 4 may include all the so-called neighborhood roads, or those which, from their location, can at most be used only as a means of communication between small sections of territory, and for school purposes, but which the public has a vested right in, and is bound to keep in repair. This class of roads should be located, as much as possible, to accommodate the inhabitants of the section of territory through which they pass, and, if necessary, they may be located on almost any line or grade, so long as the location is one that does not endanger the lives of persons or animals that are compelled to make use of them; but, of course, a judicious use of practical common sense in their location will save the taxpayers money in the way of maintenance, and the public much vexation in their use. Next, all highway taxes should be collected in money by the county treasurer, and paid over by him on warrants issued by the proper authority. All work of construction or repair of roads should be done under some form of the contract system, the contractor furnishing a guaranty in the form of an approved bond, or to receive no pay until the completion of the work to the satisfaction of the proper officers.

HOW CAN THIS RESULT BE SECURED?

There should be appointed and duly commissioned, by the governor of the state, five persons, who shall constitute an executive board of highways, two members of which should be civil engineers and one a lawyer. The remaining members

may be men of business ability. The duties of this board should be to divide the state into suitable highway districts, consisting of, say one county, more or less, according to the circumstances of the case, having more regard to the density of population and the topography of the country than to the present political divisions, the design being to, as nearly as possible, adjust the total mileage of roads so that the cost of maintenance shall require as light a tax as possible on the people. They should determine all question of dispute in regard to the proper classification of roads made by the district boards, hereafter described, when appealed to them. They should examine and approve all plans for bridges on roads of the first class and the plans for all bridges of two hundred or more feet span on other roads. They should keep complete plats and records of the notes of location and profiles of grades, together with copies of the plans and strain-sheets of all bridges on roads of the first class; and in cases where roads of the first or second class run through two or more districts, they should have the power to call special elections to vote on the question of the issue of bonds for the grading and paving of such roads through the several districts, and a majority vote of the people of the several districts as a whole should decide the question (provided, however, that individual districts may, by vote, issue bonds for the purpose of paving or grading that portion of the said road that runs through their territory, independent of other districts, at any time they desire to do so).

They should have power to examine all applicants for the position of district engineer, and to grant certificates to all who can pass the required examination.

They should annually make a full and complete report of their work to the governor, together with such recommendations as they may think proper.

There should be created two offices—a superintendent of highways and a district engineer. These officers should be elected by the voters of the district, and they should each hold their office for a term of two years, and should give good and sufficient bonds for their official acts. Each should be permitted to name his own deputies, if any were required. And

before a person could be eligible for the office of district engineer, he should be required to pass an examination and secure a certificate from the executive board. The duties of these officers should be as follows: The two together to constitute a local board, who shall have a general supervision of all highways in their district, and make a classification of the same. They should divide the district into such number of precincts as may be most convenient for the purpose of contracting the work of maintenance or repair of roads and bridges to advantage. They should open all bids and award all contracts for grading or repairs on roads, and for the construction of bridges.

They should have the power to establish, alter or vacate highways when petitioned for by the citizens of the district; and, in cases of relocation of highways of the first or second class, they should have the power to condemn land for road purposes, or for the purpose of constructing proper outlets for drains through adjoining lands; but before commencing condemnation proceedings, such plans of drainage, or of changes in existing highways should be approved by the executive board.

They should annually file with the board of county commissioners, or other proper authority, a sworn statement of the amount of work done during the year on the roads in each of the different classes, and of materials or supplies purchased, and of the amount of funds on hand, and also with an estimate of the amount of funds that will be required for the maintenance of the roads and bridges in the several precincts for the following year, and also an estimate of the amount of money which can properly be expended in grading and paving or macadamizing of roads in the several classes, from which estimates the commissioners should make the proper tax levies.

They should annually report to the executive board the number of miles of roads of each class in the district; the amount of grading and paving or macadamizing done; the cost of the same; the character, amount and cost of bridges erected, and of repairs to existing bridges, together with an estimate of

the amount of funds required for the several purposes for the following year.

Besides his duties as a member of the district board, the superintendent of highways should have the general supervision of all highways in his district when the district board is not in session. He should receive all petitions for new roads, or changes in existing ones that may be filed with him by citizens of the district. He should examine all routes petitioned for, and, if satisfied that the new road, or the change of the old one, is desirable, should notify the district engineer to make a survey of the same. He should advertise for bids for the general repair or the construction of the roads and bridges in his district, and, after the work is awarded by the district board, should sign all contracts. He should purchase all supplies necessary for the use of the district in the care of the roads. He should issue all warrants on the road fund on the treasurer's fund of the county where the work was done, based on the monthly estimate of work done by the contractors filed with him by the district engineer. He should keep a full and complete record of all his acts, and a register, by numbers and amount, of all warrants issued by him, which books and records should be open to examination by the county commissioners or the executive board at all times, and should have his office at the county seat, or in the city or town most convenient of access to the citizens of his district.

In addition to his duties as a member of the district board, the district engineer should make all surveys of highways in his district, and properly mark out on the ground all construction work for the contractor, and keep complete records of the location and field notes of surveys of highways, together with plats and profiles of all grades established, and copies of the plans, strain sheets and bills of material of all bridges built, and copies of the final estimate or measurement of all grading, paving or macadamizing done. He should furnish the superintendent of highways with plans and, if necessary, strain sheets for all bridges, and for bridges on roads of the first class, and for all spans of two hundred or more feet in length on other roads; he should first submit his plans and strain sheets to the executive board for approval before finally

giving them to the superintendent for the use of builders. He, too, should have an office at the county seat or most accessible point for the citizens of the district, and his records, books, etc., should be open for examination by the proper county officers or the executive board at all times.

Such, in short, is the plan the writer would propose as a remedy for the present expensive system, in use in most states, of working the roads. That it may have weak points, he does not doubt, but he also believes that it possesses some merit. It is quite probable that some states have laws at the present time wholly or in part similar to the plan outlined here; if such is the case, the success or failure of the plan, where it has been put in practice, can be easily learned from those who have tried it, and who can readily point out its defects, for no amount of theory is equal in value to an experiment, in the matter of either making laws or putting them into practice. He is convinced, however, that the plan he has outlined will be productive of better roads and a material saving of money to the taxpayers in states that can be induced to try it.

WAGON ROADS.

J. H. FORSTER.

Admitting that good wagon roads are of great advantage to a country, and that our roads in general are not what they should be, not what they might have been, if the labor and work expended had been judiciously applied; we are of the opinion that better methods of improvement are in order.

We hope that some wise plans may be adopted from the general discussion of the state of our highways now going on, and that practical methods may be reached.

But in many newspaper articles on country roads, I think our country is treated unfairly. It is not fair to compare our country roads with those of Europe. Michigan for example is a new state. In Ingham county where I reside, the oldest settlers boast that it is 35 or 40 years since they built their first log cabin in the wilderness, reaching their destination by

Indian trails. Thirty-five, forty, even fifty years—what an age! Compare it with some older civilization which we call modern. The English, French and German people with whom we are unfairly compared in the matter of roads, have been building for a thousand years. Their primary teachers were the Romans. Good military roads were as necessary to those invincible historic conquerors as are railroads in modern times. They used their power and compelled the conquered people and innumerable slaves to work upon their marvellous thoroughfares. But as I understand it, their system of roads was limited, not general. They built only a few great thoroughfares connecting important parts of the conquered country. It was so on the continent.

But in Michigan no despotic power has hauled us out to work on the roads. On the contrary, we have lived under the mildest of regimens. Our Centurian has been the popular *path master* (not road master!) carelessly elected by a *viva voce* vote of men and boys, with no special qualification, no ambition other than to get through with the job of making bad roads worse as cheaply as possible. This statement is made in general terms; there are praiseworthy exceptions. Better, more carefully made roads are becoming more common. Many farmers are fully aware of the importance of good roads.

Many enthusiastic advocates of good roads will have nothing but stone, or McAdam throughfare. At this time the proposal is absurd. I have to work 1½ miles of road on my farm. A first-class stone road would cost say, $5,000 per mile. My farm would be taxed $7,500. It is assessed at $15,000, therefore it would take one half of the farm to build the road. But from whence is the money to come? By mortgage? The state would better confiscate the farm at once and set me at work breaking stone for a living. In no possible way could the McAdam ever reimburse me for the tax, even if I could pay it.

Therefore, so far as we farmers are concerned, I would say, "go slow."

Farmers use only certain local roads. In our section, owing to the nature of the soil as much as anything perhaps,

we have pretty good roads. By good drainage, turnpiking, putting gravel and sand on a clay road-bed and clay on a sand road-bed, good results follow. Our roads, even under a lax system are slowly improving.

The general public use all the roads in a county, and many who travel, pay little, if any road tax anywhere. So it seems to me if the present system of road building is to be improved or changed, the work should be placed in the hands of the state, and all villages and cities as well as townships and counties, all railroads and ship lines should be taxed to build county or state roads.

It would be unjust, unfair and ruinous to throw the burden of costly road building upon the township. You would kill the goose that lays the golden egg.

Unfair as it might seem at the first glance, to tax steamers and railways for land roads, I think upon examination the tax will not appear unjust.

In the first place, millions upon millions of the people's money are expended in the construction of harbors, light houses, locks, dredging, etc. The common roads of the country lie behind all these.

In the second place, good country roads are a very important factor in railroad traffic. What is the condition of things to-day, especially in the western states? Railroads may be viewed as the main streams of inland traffic. The common roads as innumerable feeders. It is of the utmost importance in railroad traffic that the flow of passengers and freight be strong and constant all the year round. But the choking up of the common road feeders by mud, is a great draw-back. When the roads are good after harvest, all of the railroad stations are filled to repletion. The farmer hurries in his produce irrespective of the condition of the markets, while the railroads are unable to remove the crop fast enough. All are working under undue pressure and at a loss on one side, at least the farmers.

During the muddy term, the railroads receive a minimum of freight and run empty cars into half stranded cities.

Good roads, all the year round would even up things and conduce to general prosperity.

In a new country like ours, under so many varying conditions, the permanent improvement of country roads must be a work of time—much time. It will not do to force matters. The best engineering talent (such as we have here!) must be employed in planning and executing, supplemented by wise and honest legislation and *administration.*

HIGHWAY LAWS OF NEW YORK.

BY O. C. GILLETTE.

At the request of our secretary, I have made the following digest of the highway laws of the state of New York.

There has grown up in this state in process of time, a vast body of fragmentary and disjointed legislation, and it requires more skill than I possess to tell in all cases what is law and what is not. For instance: I read through two or three pages of an enactment in reference to highways lying in two or more towns of a county, only to be told in the last clause that this act applies solely to counties lying contiguous to cities having a million or more of inhabitants.

In each town in the state outside of cities and incorporated villages, there are annually elected one or more commisioners of highways. They have supervision of the roads and bridges of the town. They are to divide the town into road districts and to appoint officers called Path Masters, who see that the highway tax is properly worked out on the roads. The highway commissioners may expend not to exceed $250.00 on the roads and bridges of a town. If they require more than this, they must give due notice previous to the annual town meeting, stating the objects and the particular amount required for each.

They may cause a survey of roads which are not well described, or which, though not regularly laid out, have been in public use twenty years or more.

They may buy a road scraper, and the supervisor may, if the electors at an annual town meeting shall so vote, purchase a stone crusher for the use of the town.

All male inhabitants of the town between the ages of twenty-one and seventy are liable to be assessed a road tax, to be worked out on the highways of the road district in which they live. There are certain commutations.

There is a cash commutation, also if a person takes down his highway fence where snow is liable to drift, he may be allowed the cost of taking it down and putting it up again. If he erects and keeps lighted a street lamp, he may be allowed not to exceed six dollars per annum for that service. If he plants shade or fruit trees along the highway he may be allowed on his highway assessment, one dollar for each four trees planted, up to one-fourth of the amount of his tax for that year.

No road may be laid through any orchard or vineyard, without it shall be declared necessary by a commission of three, appointed by the county judge, and they shall apportion the damages, and their proceedings shall be approved by the appointed judge.

There are certain fines for driving over bridges faster than a walk. These fines vary from one dollar to twenty-five, according as the span of the bridge varies from twenty-five feet to two hundred.

Any bridge whose length is two hundred feet or more, or which has any span of one hundred feet or more, need not be accepted and paid for by the town until it has been tested by the state engineer, and been declared to be a proper bridge, and built according to the contract. All bridge contracts are made subject to this provision.

Bicycles and tricycles are regarded as carriages, and are under the rules.

The country roads of the state of New York are about as bad as they can be. The soil of a large portion of the state contributes to make them so.

I need not describe to you the vicious results of the system of working out highway taxes under the direction of someone who ordinarily has no conception of how to make a good road.

Eli Perkins says, "The average farmer does not know how to make a good road, God never intended that he should." It seems to me that when roads are laid out, made and main-

tained under the supervision of skilled engineers, then we shall have good roads the year round, with scarce any more, perhaps even with less expenditure than at present.

FLORIDA ROAD LAWS.

S. C. HODGMAN.

To the Members of the Michigan Engineering Society:

I have been requested by your Secretary to give you some information in relation to the road laws in Florida. This is quite a difficult thing to do, as the state of Florida seems to guard her laws with a jealous care lest someone not of the elect should find out what they are and make hard times for the lawyers. After many trials I have succeeded in getting a look at a copy of the law of 1888, which was amended in some particulars by the last legislature, and have been told what the alterations were.

To begin with, in order to understand fully the law, a sketch of the system of local government is necessary.

In that system the county is regarded as the unit and all local government is subordinate to it. The county is divided into commissioner's districts. In this (Polk) county, consisting of about fifty-five townships, there are five such districts which are also subdivided into precincts for voting purposes, the precincts sometimes consisting of several townships. A form of election is bi-ennially gone through with which does not elect, but recommends the successful candidates to the governor for appointment. (This is in order to keep the darkey out). The commissioners form the county government—with some oversight from the county court. Local or neighborhood officials are few and far between. Even the common schools are dependent on the county board of school commissioners for everything—teacher, salary, length of term, repairs of school house, etc.

The title of the law is

An Act to Provide for Placing and Keeping in Condition the Public Roads and Bridges, and the Laying Out and the Construction of the Same, and the Raising of Revenue for that Purpose.

SECTION 1. Each county commissioner's district is made a road district. (Remainder of section repealed.)

SEC. 2. Repealed.

SEC. 3. Provides for the examination of roads and bridges, ascertaining the number of miles in each district.

SEC. 4. Shall advertise at least four weeks for contracts for keeping in repair roads and bridges, also "making, altering, working, repairing, fixing and constructing roads and bridges."

SEC. 5. "The working, making, altering, repairing, fixing and constructing" shall be let out to the lowest bona fide bidder by districts for one year, contractor to give bond, etc.

SEC. 6. Superintendent (commissioner) to personally examine from time to time all roads and bridges of his district—necessary work or repairs to be done at expense of contractor.

SEC. 7. Repealed. (Male persons over twenty-one and under forty-five, subject to work not less than three or more than six days.)

SEC. 8. Repealed. (Superintendent to furnish names to contractors.)

SEC. 9. Repealed. (Contractor to give notice of time and place to work.)

SEC. 10. Repealed. (Penalty for failure to work.)

SEC. 11. Repealed. (Justice of peace to issue capias for defaulter. May commute at 33⅓ cents per day.)

SEC. 12. County commissioners shall levy tax of not less than one mill or more than two mills on all real and personal property subject to taxation, as a road fund (and for no other purpose).

SEC. 13. All bills and accounts to be audited by board of commissioners, and paid by their warrant on county treasurer out of road fund.

SEC. 14. Pay of commissioners $2.00 per day (no extras).

SEC. 15. Same.

SEC. 16. All new roads to be on section or subdivision lines, or as near as practicable.

SEC. 17. Width of all public roads to be not less than twenty feet (no provision for sidings).

SEC. 18. Commissioner shall erect mile and "sign posts;" shall have roads graded when necessary by ditching and crossways wet and boggy places.

SEC. 19. Repeals all laws inconsistent, etc.

SEC. 20. This act to take effect on approval of governor.

It will be seen by this summary that there is no provision for a survey or record of a road—no provision for condemnation of lands for a route, and no provision for damages in any case. The lands of non-residents may be traversed in any direction at the will of the residents without redress, unless through the courts.

When a public road is desired by the residents of any locality, a petition, with as many signers as possible, is presented to the county commissioners, accompanied by a rough diagram giving a more or less approximate idea of the location of the road. No notice is given to non-residents or others interested. The commissioner for that district is supposed to examine into the matter and recommend, or otherwise, the laying of the road. If he reports favorably, the board declares the road laid out. If any damage is claimed the petitioners must pay it—the county will not—at least in this county. The commissioners seem to vie with each other in saving all the expense possible to the county, and the one who shows the least expense is the best man—for re-election.

When the commissioner chooses, he can recommend the building of a bridge or crossway at the expense of the county.

There is something to be said in favor of this system as the country is now situated. Travel is not confined to roads except when the land is fenced on both sides, and it is expected that when the country is more thickly settled that new laws will be called for to suit the circumstances. I have an impression that in some of the older counties the whole matter of road laying, building and repairing is left with the county, and they make their own laws on that subject.

In case a person wishes to enclose his land through which a road runs, he can petition the commissioners to change the

route, which they will generally do, on a proper showing, unless natural obstacles prevent.

The improvements that I would suggest are that a system of main roads should be provided for, which should be kept on lot lines as nearly as possible, unless inconsistent with the best grade. Those main roads should be carefully surveyed and monumented, and a full set of field notes and a correct map of the same filed in the proper place.

That a county or district engineer should be appointed who is an expert in the laying out and construction of roads, and who should have the whole charge of the details of laying out and working those main roads.

That the whole amount of the highway fund should be expended on those roads, except, perhaps, what might be necessary for bridges on local roads. And when there is no necessity for removing obstructions on those main roads, the funds should be used for the improvement of the road bed by claying or otherwise, so that the result would be, in the future a complete system of good solid roads, mere local roads being left to the care of those who use them until the main roads are completed.

That the width of main roads should not be less than forty feet, of which at least twelve feet should be reserved for sidewalks. The road bed when made to be confined to the center of the road, and the planting of shade trees should be provided for.

Provision should be made for the condemnation of right of way and liquidation of damages where damages are claimed; also for written donation of right-of-way by a definite description of the land used for the road.

Provision should be made for the expenditure of the highway moneys in the localities where they are raised, instead of using them as a general county fund, to be expended where the interests of the commissioners may indicate.

The conditions of the highway problem are very much different from what they are in Michigan or any of the northern states. The soil is different. Heavy teams are not required for farm work and, as a consequence, are used very little upon the roads, nearly all the hauling being done with one horse or

mule, or by a pair of small oxen. Sometimes, even, one ox is used in a primitive cart. From four to seven hundred pounds is the usual load. As more northern, or *progressive* southern people come in there will probably be a demand for better roads. They will, bye and bye, begin to see how much time, labor and capital is wasted in going to town or coming home with a quarter of a load on the wagon. It seems but little now, but it will appear large enough when they begin to reckon it by the year.

I am inclined to think favorably of a "local option" in highway matters, so that more advanced counties can control the system best adapted to their needs, while the less thickly settled ones could use a simpler plan until a better one was needed.

I will not, in this paper, enter upon any discussion of the engineering problems involved, as they would not, probably, be of much, if any, interest to *Michigan* Engineers.

I take this occasion to assure you, gentlemen, of my continued interest in all your doings and that, did Providence permit, I would be very glad to meet with you again and to take my old acquaintances by the hand (but wouldn't my teeth chatter?). If I could be transported instantaneously, I would come loaded with flowers and fresh fruits for your delectation.

Haines City, Polk County, Fla., Dec. 16, 1892.

ROADS AND ROAD MAKING IN OKLAHOMA.

BY JOHN J. WATKINS.

A very brief description of Oklahoma may not be out of place before entering upon the subject matter of this paper, as indicated by its title.

Oklahoma, especially around and about Guthrie, the capital of this territory, is mostly a rolling prairie, interspersed with numerous small streams, many of which go dry, or nearly so, in a dry time, with patches of timber—oak, elm, walnut etc, lining the banks, as well as scattered in openings here and there upon the prairies.

Nature seems to have vied with herself in forming the beautiful landscape of this new country over her former efforts in the older settled countries or states. Its beauty is not one of awe inspiring, like craggy cliffs, lofty peaks or deepening canyons beyond the power of the eye to penetrate, but one that fills the whole soul with ineffable delight, awakening responsive chords in the soul's soliloquy—

"Here let me live, if live I may,
For many years while locks grow gray;
When parting time have bekoned me
On hill top lay, then shall I see
In rising at the trumpet's blast,
E'en grander sights than were my last."

Aside from the beauty of locations for settlements, the fertility of the soil is the great attraction of the many who are seeking homes here. Contrary to general expectation, the uplands in many cases are fully as productive as the bottoms; and for cotton and corn, are seldom inferior in quality and quantity of the crops, while much more easily broken up, and can be cultivated at all times, wet or dry.

The fertility of the soil is probably due to the complete admixture of clay and sand; the clays not being tenacious, but quite ochreous; and the sand without much grit, and largely devoid of gravel; in fact, you may in many places on the uplands chop all day into the earth with a sharp ax, and scarcely perceive the edge to be blunted or rounded.

On the opening of this country to settlement, home seekers whether afoot, on horseback, or in "prairie schooners," (covered wagons,) went or drove ad libitum in any and all directions; in consequence, roads were made cutting each other at all angles, because of the feasibility of traveling in the directions desirable and securing a good road, except when the streams and "draws" or ravines made it necessary to diverge from the chosen direction, and pursue a course along the side of the stream or "draw," to obtain a fording place over the stream, or a crossing place through the "draw" on a lower plane, where ascent would be less difficult.

Roads, it is very probable, over grounds in a state of nature were never found better in any state or country than in this

territory; in fact they are to-day, with all the immense travel and the heavy freighting from place to place, in very fair condition, except in siding places, or on the ascent of hills, with scarcely any road labor having been performed; on the places referred to with the constant travel and heavy freighting they become worn. After heavy rains, under such circumstances deep cuttings in these porous soils are inevitable.

In the old Texas cattle trails which pass through this territory, are to be seen cuttings caused by rain and travel of from four to eight, and even ten feet deep; of course the latter are on hill slopes; even in the city of Guthrie on the side ditches when there is much descent, in some streets the wash and cuttings have been made from ten to twelve feet deep; in fact from the looseness of the soil on account of its admixture, there is great tendency to wash and cuttings on all the traveled roads.

By federal statutes as well as territorial, all section lines are declared highways, and are being fenced out and worked some.

In counties and townships each, the highway and bridge tax, is five mills on the dollar; this while seemingly quite adequate, provides but a small fund, because so little of the land is "proved up," the title being yet in the government and not liable to tax; but the poll tax is four days or dollars per capita for all men not over forty-five, and from the fund thus derived, the most of our labor on roads is secured,

Every "draw" or ravine needs bridging as well as the streams; this makes a necessity for an ample road and bridge fund, while so little is available, consequently roads cannot be made as they should be, and the country is checkmated in its progress accordingly; but it does progress notwithstanding these disadvantages, and that "right smart," as the western or southern people say.

Each township trustee divides his township into as many road districts as he deems necessary. In this township, and generally throughout this county, (Logan,) they are divided into four, the same as the school districts, giving nine square miles to each district. The road overseer cannot charge for more than twenty-five days work, however many he may be occupied, at one dollar and fifty cents per day. In this district

No. 2, Guthrie township, having all the roads leading to and from Guthrie, with all the incoming and outgoing travel, heavy freighting to surrounding towns, log lumber, wood, brick, stone or rock, and sand hauling from the Cinnamon river for the needs and building up of this growing city, now over ten thousand, makes an outlay of from fifty to two hundred entry days necessary for the overseer with but twenty-five days pay. Great are the honors of overseer road district No. 2, Guthrie township!

Now for the second part of the paper, *road making*. The main travelled road from Guthrie to Downs, Kingfisher, El Reno, Reno City, and the newly opened country of the Cheyenne and Arrapahoe reservations, became next to impassable on the hill slope immediately west of Guthrie. This was said to be the worst piece of road between Guthrie and the before mentioned cities. By heavy rains and constant travel of four and six horse freighting teams, the wash had cut the road in fearful holes and trenches down to the bed rock, which underlies the surface soil from two to ten feet on many of such slopes. The road overseer of district No. 2, Guthrie township, started out to repair it, being in his district, and did it in the following manner.

The rocks that were laid bare were broken and picked off on the tops of some, others were blasted and the debris broken into sizeable pieces, the holes and trenches were partly filled or riprapped with this material; next small saplings and brush were cut in the adjoining timber and laid on this riprapping with the tops uphill, commencing at the top of the hill, making them shingle in layers one upon the other, care being taken to lop the branches so as to spread them in fan like shape when adjusted in the trenches. They were put into the washouts from three to four or more feet deep, as the occasion required, for nearly one quarter of a mile, the fills being from four to six feet wide, and as many feet above the ordinary surface of the road; these were weighted down with heavy fence posts, with occasionally a man or two's weight on top as the covering progressed to keep the scrapers from disarranging the layers. We commenced to cover at the foot of the hill, first with scrapers full of broken rock, then of earth; as the brush and

saplings became well covered and somewhat compressed, the fence posts, one at a time were removed *farther up hill*, and in this manner to the top of the hill, As soon as we had any part covered the travel was turned upon it so as to more thoroughly compress the timber and pack the other filling before the crowning of the road bed should take place. While the work of filling the trenches was taking place, other teams and tools were employed in plowing the side ditches. Most of the way it was soft rock, which with a heavy road plow with coulter, two or three men riding the beam and sufficient teams, we were enabled to plow some furrows; then came the scraping out; this was continued alternately plowing and scraping, till we had side ditches four feet deep and wider than deep. Where the rock was too hard for the plow, men with picks, crowbar, sledge drills and old axes, subdued the refractory portions.

After the road bed had been properly filled and ballasted with broken rock, came the crowning, which was done in the ordinary manner with scrapers, after which came the levelling and smoothing of surface of road bed. As we had no grader we were left to our other resources, and as the adage has it, "necessity is the mother of invention." We took the fence posts used for compressing the timber, laid them side by side as the pieces of a harrow with the distance of six or eight inches apart and chained them in such a manner; then in hitching to it with two span of large horses, one end or side was made to be in advance of the other about two feet. The two drivers mounted *this grader* standing up, and thus this road bed was levelled and properly crowned. Of course, it will be understood that these posts were made to run nearly perpendicularly to the line of the road way. What obliquity there was, was given it by running one corner in advance of the other as before stated.

Lateral ditches, quite shallow, were run diagonally from the road bed to the side ditches, so that no part of the road bed had to carry any water except what fell on its immediate surface, and that by the crowning was quickly conveyed by one of the lateral ditches to the side ditch. There were probably a dozen of these laterals on each side of the road bed.

This road takes all the travel westward from and to Guthrie, and has been in wear since last spring, and notwithstanding the present year 1892 has been unprecedented for very heavy rains with attending cuttings, still it has stood the test during this time without wear to any considerable degree, and only as might naturally be expected. From being the worst road in Oaklahoma, it is now acknowledged to be the best hill side road from Guthrie to the Cheyenne country.

This is one of three roads repaired or built in the same manner, all of which are doing good service.

Now comes the question, why commence at the *top of the hill* and shingle the young saplings as set out? Because the waters that may run upon the road at the upper end, will after seeping through the earth to the timber, follow the timber to the riprapping below, and then will course through the stones till lost in the earth, leaving all the material above the riprapping in place and the whole structure remains solid. But had the fill from the saplings been made from the lower end up the hill, every rain would have laid bare the lower part of each course of the filling, and made just so many places for the water to ooze out and widen the old cuts. It should be observed that the riprapping on the road bed before the crowning caused the crown surface to dry out very much sooner after each rain, and tend to solidify the road bed as well as its preservation, enabling it to resist the heavy pressure of the freighting teams.

January 1, 1893.

GENERAL STATUTES OF NEW HAMPSHIRE —MAKING AND REPAIRING HIGHWAYS.

RAY T. GILE.

1. Towns shall annually raise such sum as they judge necessary for the year, to be assessed and collected as state taxes, for making and repairing highways and bridges therein.

5. Towns may choose as many surveyors of highways as they think proper.

6. If none are so chosen, the selectmen shall appoint surveyors.

7. Surveyors enter upon their duties on the fifteenth day of May.

8. On or before May 15, annually, the selectmen shall limit the several surveyors' districts, and give to each surveyor a list of the persons in his district, with the highway tax against each, and a warrant to collect the same.

9. Every surveyor shall give to each person named in his list, or leave at his abode, a notice of the amount of his tax, and of the time when, the place where and the tools with which he shall attend to work out the tax, four days before the day appointed, and may require any person to work out not more than one-half his tax in labor of animals.

12. The town may determine the prices to be paid for labor, materials and use of tools applied in working out the taxes; if not so determined they shall be fixed by the select men.

13. The surveyor shall allow to each person attending to work out his tax, the time necessary to travel from and to his home.

17. If the highway taxes in any town are insufficient for the suitable repair of the highways and bridges therein, the selectmen may cause them to be put in repair at the expense of the town, but not until the money raised by the town has been expended.

24. Highway taxes shall be paid in money, when the town, at the time of raising money for which the tax is assessed, so

direct; and such taxes shall be committed to the collector, and when collected shall be expended in repairing the highways, by the selectmen or surveyors of highways, as the town may direct.

27. Towns may, by vote or by-law, authorize their selectmen to contract for keeping their highways and bridges, or any part thereof, in repair for a term not exceeding five years.

37. Towns are liable for damages happening to any person, his team or carriage, traveling upon a highway or bridge thereon, by reason of any obstruction, defect, insufficiency or want of repair which renders it unsuitable for the travel thereon.

Highways not in any town or place liable for the repair of highways shall be made and repaired by the county; and every county shall be liable, as towns, to individuals and to the public for neglect therein.

F. HODGMAN,

Dear Sir:—Many of the towns in New Hampshire still cling to the Highway District system in the repairing of the county roads.

In the town of Littleton the farmers are unwilling to adopt a new plan. It is customary for the town to raise one-fourth of one per cent of the total valuation each year for the repair of highways. The inhabitants of the village have tried for several years to get the town to adopt a better highway plan; but failing in that they have recently had the village set off, by the action of the state legislature, into a separate highway precinct.

It is proposed to begin the use of broken stone on the streets. I think, in time, the farming community also will be led to see the advantage of better roads and be willing to help pay the expense of making them so.

In our town, this year, outside of the village highway precinct, the highway tax was raised half in money and half in labor.

Littleton, N. H., Dec. 27, 1892.

RAILWAY AND HIGHWAY.

H. E. RIGGS.

The last three or four years have seen a decided effort on the part of our citizens to secure better public roads. Engineers have discussed the matter more thoroughly, and it has been brought to the attention of the public at large as never before, through the medium of newspapers and magazines.

It does not require much of a student to get at the point of the statistics. Good roads pay, and they pay well. It would be the greatest godsend to the people of this country could we have such a system of roads as France possesses. The stagnation of business in our smaller towns in certain seasons of the year would be greatly reduced; the farmer would be enabled to reach the markets with his produce at all seasons; and he, as well as the consumer of his produce in the cities, would be financially ahead.

I have been asked to say a few words on the relation of the railroad to the country road, and have also been asked what, if anything, the railroads should pay towards the cost of improving these roads?

If I may be permitted, I will lose sight of the term "country roads," and give a few remarks on the relation of railways to all roads crossed by them.

That railway companies suffer a loss of revenue on account of the villainous dirt roads and narrow tires in use on them, I do not question.

I do feel that it would be impracticable and impolitic to call on the railway companies to contribute a sum of money to be expended on highways under the direction of any such road officials as we can at present boast. A railway company has so many items of expense which are outside of the cost of the maintainence or operation of its road, and its relations with the people at large are frequently of such a nature, that any demand for additional taxes, and particularly for such a use, would be met with refusal and with long continued opposition in the courts.

It is to be regretted that the relations between railway managers and the people are not as harmonious as they should be. There has been a tendency on the part of demagogues and politicians, in order to gain a certain kind of petty notoriety, to raise the hue and cry against railroad companies. Newspapers have taken up the cry, and have aided in creating a popular feeling of distrust and enmity toward this class of corporations. I think that it is the farmer who is most suspicious of the railroad companies. I find this spirit of distrust most strong away from the cities.

This state of affairs should not exist. It has led in some states to legislation alike ruinous to the interests of railway and state.

Permit me to quote from a recent report of the railroad commissioners of the state of Kansas:

"It is believed by the board that questions of paramount public concern enter into the business of railway construction and management; questions of statesmanship most difficult to master with justice to the public and the companies, a solution of which can never be successfully reached without a recognition, as a fundamental fact, that public and corporate interests in this relation are so completely identical as to involve the prosperity or adversity of each in that of the other. They are moulded from common element of mutual interest and dependency."

The railway companies are closely allied with the people in their efforts to build up a state, and they share the burden of taxation; they open up remote districts to settlements; they are makers of cities.

I think I can safely say that the manager of every line of road in the country will join most heartily in any effort to build up any county or city through which his line passes. He will do so from exactly the same motive as would influence any other business man, awake to the best interests of his business.

There is one feature in the relation of railway and highway that is of highest importance, that involves an annual expenditure of much money and an annual loss of many human lives. That feature is the *crossing*.

You will all admit that a railroad crossing your highway at grade is an element of great danger. It is particularly so, if

by reason of obstructions a clear view of the tracks cannot be obtained.

A glance at statistics will show that more lives are lost every year at grade crossings than are lost in what is supposed to be one of the most dangerous of occupations, that of coupling cars. More people are killed annually at grade crossings than are killed while riding as passengers on trains.

The following figures taken from such of the Michigan reports as I have will bear me out in this statement:

Date of Report.	Killed at R. R. Crossings.	Killed Coupling Cars.	Killed Passengers.
1886.	8.	11.	2.
1888.	19.	10.	7.
1890.	29.	24.	7.
1891.	26.	8.	5.

This shows something of the need of proper protection of life at these crossings. From the commissioners' report just issued I see that there are in the state, 7,493 road crossings, of which 211 are either overhead or under crossings. Of the grade crossings 495 are protected by flagmen, gates or automatic signals, while 6,998 are unprotected except by the sign board required by law.

The loss of human lives as shown in the reports given, in all probability represents a large expenditure in settling claims. During the same years nearly as many people were injured at crossings—another probable expenditure for damages.

I believe that it is for the interest of railway companies as well as of the public, that these crossings be protected. Where the crossing is in the country, the view unobstructed and no extraordinary travel on the roads, the sign board required by law is generally sufficient. In towns and cities where there is more travel on roads and more general use of tracks by engines and trains, some means of protection should be afforded.

The best, in fact the only certain means of protection is the total abolition of grade crossings at important points. There are few, if any, railroad managers in the country who would not heartily wish that *all* grade crossings could be abolished. It is a pleasure to know that many roads are mak-

ing this necessary improvement as rapidly as possible in the cities.

The maintenance of gates, with the necessary attendants or flagmen, is costly and unsatisfactory. Hardly a week passes that our attention is not directed to some accident at such a crossing. In Chicago a few weeks ago eight or nine lives were lost by a street car being struck at a crossing protected by two flagmen. Parties using the road take greater risks at these so-called *protected* crossings than where there is no protection but the sign board.

I should favor an effort to secure the co-operation of the road officers and railways, and let the railways pay their share of highway improvements in the erection of substantial viaducts at all main arteries of travel. Let the county or township grade and pave the road and approaches to the viaduct and ask the railway to provide the bridge. When done your road will be safe and a matter of pride to all.

To summarize briefly: 1st. Any laws passed and put in force, that will tend to improve the highways, increase business and afford constant access to the outlying districts, will be of benefit to the county and state, and as a natural result cannot but be of utmost benefit to the local business of the railroad companies, owing to the close relations and mutual dependence of public and railway interests.

Secondly, The railways can best aid in the construction and maintenance of these roads by abolishing, so far as possible, grade crossings at the main arteries of travel. I do not think that any special road tax should be levied on the railroad companies, but an effort made to secure their co-operation in the erection of viaducts, and have the railroad proportion of expense levied in this way.

THE RELATION BETWEEN RAILWAYS AND PUBLIC HIGHWAYS

AND HOW CAN THE RAILWAY COMPANIES BEST ASSIST IN THE IMPROVEMENT OF THE PUBLIC HIGHWAYS, AT THE SAME TIME FURTHERING THEIR OWN INTERESTS?

E. FRENCH.

In the recent discussions regarding "better roads" it is not unusual to hear the opinion expressed that "all the freight will eventually reach the railways regardless of the condition of the highways." This, I believe, will not be true so long as corn is used for fuel in the west, straw and other products of the soil are burned all over the country, and forests are left standing for want of facilities for transportation of the product.

The relation between each particular railway and the highways in the region through which it passes, is dependent upon so many and such diverse circumstances that each must be in great measure a law to itself, and we can hardly do better than to consider briefly some of the circumstances under which railways might reasonably be expected to aid in the improvement of highways.

1st. In the case of a fertile district or town lying about midway between two competing lines of railway, where the improvement of the highway leading to one of the lines might secure to it the bulk of the traffic from such district or town.

2nd. In towns where there are two or more lines of railway, the one whose depot is farthest from the business center may secure the bulk of the traffic by a judicious expenditure in the improvement of the highways leading thereto.

Although these are special cases, they are the ones that railway managers will insist upon having attended to first with the means they are asked to appropriate for the purpose. They will also insist that none of the means appropriated by them shall be used in increasing the facilities of their competitors.

While they will admit that the *general* improvement of highways will make a considerable accession to the earnings of their

lines, they will hardly consent to join voluntarily in such general improvement for various good reasons.

1st. Uniform voluntary action (if desirable) would be impracticable.

2nd. The benefits accruing to the railways would bear no adequate proportion to the benefits accruing to farmers in the increased value of their lands, to say nothing of the decreased animal power required to carry on their operations.

3rd. We in Michigan can hardly say where a through trunk line could spend money on the improvement of highways to the best advantage of itself, for although these lines may pass our very doors in Michigan, is it not possible that the condition of the highways in Kansas, Nebraska or Dakota may affect their interests much more vitally than the condition of highways at any point within our own state, upon the same principle that the advertising matter of a railway is generally distributed upon other than its own lines, or that agents are allowed commission on tickets sold over connecting lines?

Again, railways as public servants are obliged to keep constantly on hand the facilities necessary to move the traffic that comes to them, and in general any measure, such as the improvement of highways, that will cause this traffic to flow in a more uniform stream must have the effect to enable them to handle it more cheaply than when it comes in floods followed by corresponding periods of depression.

Yet Michigan is peculiarly situated in that the trunk lines passing through her territory derive the bulk of their through traffic from the region naturally tributary to the great lakes, and are crowded with business during those months when navigation is closed; and this usually is the time when highways in Michigan are at their worst, and the local traffic is depressed accordingly, while the through traffic is at its height. This, of course, is as this particular class of railways would wish to have it, as a congestion of business is inevitable with them in any event, and the improvement of the highways in Michigan would, in my opinion, tend to further complicate the matter.

In conclusion, I can see no way in which the co-operation of railways can be secured in this matter, except by the usual methods of assessment or taxation.

LEGISLATION FOR BETTER ROADS.

GEO. E. STEELE.

The legislature is invoked whenever anything goes wrong in the economy of the state, even to attempting to make men temperate. A large part of the precious time of the law making body is taken up in changing the name of Miss "Fide Bona" to Miss "Bona Fide," and such like, of vast import. It may be readily guessed, after making these startling statements, that we are not of the class which has implicit confidence in the legislature at once setting us on the macadam road to glory, all in the "one horse shay." Revolutions do not come by the flirt of the executive pen—except in South America. We must be content to ask the legislature to do the very best it can, as quick as it can, for the *patient* is *very low*. We must then hold up our hands and promise to do our part. Then the era of good roads will begin to throw out a faint light in the East—following it, the clear day.

It need not be expected that the legislature will move far in advance of public sentiment; and this sentiment is not at present educated up to the point of demanding good roads. Some are taking advance ground, and the subject is having general attention, but the most of our people do not realize how much is lost by bad roads. They easily fall into the ruts of "well enough," or "cost too much." Although we are somewhat behind some of our sister states, we are vaccinated, and will in due time break out with "road rash."

This period of organization must precede all else, as well in road building as in other lines. The legislature is handicapped by the constitution, which prevents it from vacating or altering any road laid out by the high Commissioners of Highways.

Article IV, Section 23, and under 11 Michigan 155, and 20 Michigan 95, confines this action to state roads, by delegating the power of Boards of Supervisors. Also by Article XIV, Section 9: "The state shall not be a party to, or interested in any work of internal improvement, nor engage in carrying on

any such work, except in the expenditure of grants to the state of land or other property."

Under this it has been decided, "that township, highways, and other local interests cannot be taken from the custody of the proper local officers." This makes the highway commissioner the *sine qua non* of township roads, or to translate the Latin, he is "Big-Injun-Me."

See also 15 Michigan 347, and 34 Michigan 46, where the commissioner is given full power to lay out, alter, or discontinue highways. I cannot here enter into a discussion of these constitutional restrictions. Whatever may be done to make the constitution a help to good roads, must be preceded by a thorough school house campaign of education, or the amendments will be killed by popular prejudice. In view of such misleading error, I believe more can be accomplished if the legislature does not at first attempt too radical changes. I admit that most radical changes are needed, but we are not to expect suddenly to emerge from the "corduroy" road to the "Appian Way." Then, in my judgment, such a plan should be adopted as would, by increasing public attention and appropriate legislation, gradually bring us into better condition.

Let us map it out.

1. Preserve the township system with some modifications for local or unimportant roads.

2. By a local option plan provide that any county may set in operation a county system with three county commissioners, who are distinct from the board of supervisors, and who shall have power of location, construction and maintenance of the most important thoroughfares. If these were treated as "State" roads, they would, under present decisions, be free from control of the township commissioner.

3. Have a county engineer who shall locate all town and county roads in conjunction with the officers named; map carefully all roads, set out work for contractors, and see that their work was properly done.

4. Do away with all building of roads by the state at large, and make the laws we have, so far as applicable, to conform to new county system.

5. Provide that by vote of the people of any county bonds may be issued, guarded by such low rate, long time, and provisions as would seem best. This money only to be used for a few important roads.

The modifications of the town system would be mainly as to the power of the commissioner to locate or alter highways. There is no check on this officer. He lays roads in the most hasty manner, and sticks to the section lines if they are well nigh impassable. We have lost enough by this poor policy already in state roads and highways, to have built a stone road the whole length of the state. As a surveyor, I have been called upon to make such locations as I knew were not best, but had no power to do otherwise. A road should be located by a capable engineer with as much care as a railroad, (permitting heavy grading,) and with curves instead of abrupt angles, all being thoroughly monumented. Authority should be given in this direction, and also to alter roads laid out so as to improve them. We would then stop expending money where it was worse than thrown away. Such poor locations are expensive luxuries. By proper application certain portions of roads already laid out could be condemned, these portions thereafter to receive not one dollar of public money. The new and best location would follow as a matter of course. The older parts of the state have their roads located, except as improvement of location could be made. But it must be remembered that, over say one-half of the state, new roads are being constantly laid out, and this will continue for many years. The question of location then becomes the very foundation of all subsequent expenditures, and should be committed to those best capable of giving it attention, free from local bias, and who make this work a study. This would be expected of the county board and engineer. It would be an advance to brush the dust off from the county surveyor and make an engineer out of him. The office is now of no consequence, and by making it the "Hub" of road construction, would be filled by men chosen with this in view, and become something besides an empty name. As to the state taking up the road building, it would seem that the day is passed. We have no use for long military or other roads. The railroads take the

place of such. We have already seen the misappropriation of hundreds of thousands of dollars in state road building, and if these are samples of state construction then deliver us from any more. County credit should be as good, or better than the state. The former cannot repudiate, the latter can. Those counties where first-class roads are built will find their credit thereby improved. Other counties not moving in the matter will retrograde.

DISCUSSION ON ROAD LAWS.

MR. HODGMAN: I don't think we want any state roads. I do not think any road would be of sufficient consequence to require the state to build it. When the time comes for such a thing it will pay to build a railroad, and when you have the railroad you do not want the state road. So I would divide our roads into simply two classes, county and township, or neighborhood roads.

For the support of the county road I would levy by statute an uniform tax of some reasonable amount, say perhaps, one mill. That should be devoted entirely to the work of building and maintaining county roads. I would levy by statute another tax of one or two mills, or whatever sum would be reasonable, for a township tax, to be paid in money for the support of common township roads. I think in the township of Climax we assess about one dollar for every eight hundred dollars of valuation. Suppose we make it two mills. That would be plenty, but I would adopt some fairly reasonable sum to be spread uniformly all over the state, both for the support of county roads and of township roads. If any sum greater than that was needed for the support of the county roads, it should be laid before the people of the county to vote upon, with detailed estimates. The persons who have the care of that should make a report to the board of supervisors of what road they propose to improve, the manner in which they propose to improve it, and the estimated cost; and that should be submitted to the people for their vote at the next election.

In the same way, the township roads should have a mill tax for their support. Make it a minimum sum. The person who

has charge of the township roads should make his report to the township authorities, showing what has been done during the past year, giving itemized statements of it in full, of what money has been expended, and the whole thing, so that every person in the township may know what was done with the money. If anything in addition to this mill tax was needed, require him to make a specific estimate to lay before the people of his township, stating what improvements are needed and the estimated cost, and let them raise it if they want to. In this way we keep the whole question of taxation before the people themselves to settle.

I would authorize the putting of tramps and vagrants to work on the road; authorize the highway commissioner to purchase the right-of-way for highways, at a price not exceeding the market value of the land, and in case he could not purchase it at that price, to call out a jury to condemn it. I should require a complete and accurate description of all road lines, whether now in existence or to be laid out, to be filed in the office of the register of deeds and in the state land office.

Country roads sometimes grow into city streets, and it is a very difficult matter to determine just where the location of that street is. I would require that these roads be established and monumented. There should be a permanent monument at every section corner and quarter section corner, and at every angle in the road, and a thorough description made. I would fix a suitable fee for recording and pay it out of the general tax I speak of having levied, both in the case of county and township roads. I would make the road laws apply to all platted streets outside of incorporated cities and villages. I would fix a penalty for destroying or removing monuments made to define road lines, and provide some manner of enforcing it. I would provide that all county roads should have permanent grades adopted; would have all heights of the county roads referred to a common datum, and if a road was on a county line, would have an established bench mark at the county seat, to which all heights should refer; show the heights of every railroad crossing; show the heights of the surface of the water in every stream; require it to be done, by law.

I would require all work done in constructing gravel and paved roads to be done by sections of some specific length, according to detailed specifications; and in case done by contract, not to be paid for in full until the specifications were complied with. I would require all graveling and paving to be completed to the grade as far as they go; adopt the grade first, gravel it as far as they go and finish it. If a road has to be plowed up, let it be but once. There might be exceptional cases where that might not apply.

I would furnish every highway commissioner with a good text book on highway improvement. I think we have people in our society to get up just such a book—some little book that, without taking much space, would go right into the fundamental principles of making roads and bridges, simply common short span wooden bridges and culverts, and giving specifications—and put that into the hands of every highway commissioner.

Now we have lots of highways in this state and everywhere else which require drainage. In certain classes of roads, clay roads especially, the most important thing is to have thorough drainage, and it is necessary to go across private property oftentimes to secure it. Hence, I would authorize the opening of watercourses across private property and provide a manner of condemning for right-of-way.

The only change I would make in the constitution would be to abolish the office of path-master and to extend the time of the highway commissioner. I would retain our present highway commissioners. I would organize a county board of highway commissioners to consist of the commissioners of the several townships. I would give to that board of highway commissioners the general control of all county roads; they should determine what roads should be county roads and what not, and authorize the expenditure of all the county funds under their direction; authorize them to employ competent road makers to supervise it.

I would require that board to make an annual report to the board of supervisors in detail—a report of all money expended by them, and where and how expended, and estimates of all improvements requiring additional money to be expended.

I would require each township commissioner to make a full report to the county commissioners, and the entire report to be consolidated and filed with the county clerk and in the office of the secretary of state.

These are the leading points I would suggest for the improvement of our highway laws. I do not think we are ever going to get any highway laws that will be perfect. It is going to be a question of time; there isn't any system that is perfect. I have corresponded and talked with engineers in other states where they have the county commissioner system, and there are grave evils connected with that. There is no perfect system, and you will never get such a one until you get a system that will put in office none but thoroughly competent honest men, men who will not be prejudiced, and they are so scarce we shall not get many. There will be no perfect roads until we get more perfect execution of the laws.

MR. HUBBEL: When I came into the Convention, I thought perhaps I had a few ideas on road making, and I flattered myself that perhaps some of those ideas were original, but after listening to the papers that have been read, I find that nearly all those ideas have been presented, so that my original ideas are mostly second-hand, and for fear that somebody will tell all the rest I know, I thought I would begin the discussion at this point.

The first point I shall make is this: We are often told that if some system of road making had been adopted twenty-five years ago and had been followed up, that by this time, we would have a splendid set of roads. If a system of making roads had been adopted in Michigan twenty-five years ago, and been followed up, we would have wasted three-quarters of the money put in. That is what I think about it. In fact we have wasted a large proportion of the money put into roads, and that waste has not been entirely because misapplied or not well done. The fact is, that the road problem in Michigan has changed, and the roads needed twenty-five years ago are not needed now. Years ago it was supposed that we needed state roads. They are of very little use to-day, and not because they never were made, and because many are not well laid out, but because we have no use for them. Men do not start out

to-day and travel thirty or forty miles on the common roads. Years ago a franchise might have been valuable, granting to a company the right to build a road from Lansing to Grand Rapids. To-day, a company would not think of accepting such a franchise.

So the necessity of to-day is entirely different from the necessity in years past, and the principal cause of this change in Michigan is the construction of railroads. People now want to get to the railroad and get there the shortest way possible. In place of laying roads from one town to another, we want a system of good short roads, all of which terminate at the railroad depot. Of course there are exceptions, but if you make a good road, or a good system of roads terminating at railroad depots, you will supply seventy-five per cent. of the necessities of the case.

Now, with this in view, any system of roads that you see fit to recommend, in my opinion, must take fully into consideration the fact that the travel is now by rail, and what we need are short roads, and roads ending at railway stations. Our roads want to be simply an extension of our railroad facilities.

It seems to me, that the only place we can begin to build permanent roads with the reasonable assurance that they will be useful for years to come, is to begin short lines at our railroad stations. The railroads are in the nature of a permanent institution, and the business is going to continue.

As for the classes of roads, I should think we need at least three. I think all classes should be upon some system, and have some specifications. I would have a first-class road, which is first-class in every respect—broken stone, or at least gravel. A second-class road which is also a good road, and a third-class road, which consists of ditches, and the spreading of the surface soil to support the road. By improvement it can be made a second-class, and by still further improvement, a first-class road.

We have heard some of our friends say, that the railroads would not do anything; that is the fact, if you tackle them in the way that was perhaps intimated by the paper.

The railroad will say: "We have built our railroad, and have opened up this country, and somebody else ought to

build the roads to reach the railroad." And still they are deeply interested in having these roads terminate at their stations. There is a way of enlisting the railroad corporation. I think the railroads would take the contract to build these roads—these short roads leading out from depots, and to be let under contracts and specifications. Nearly all railroads have a construction company, and if the railroad itself would undertake the contract of building these roads, I think the construction company could be induced to take the building of short roads radiating out. I would limit these short roads to three or four miles. I think in justice to the railroad, that a portion of the railroad taxes ought to be applied to highway construction. There might be a constitutional defect in that, but no matter about that, if it is just and right and proper, and the will of the people, that could be overcome in time. The railroads of the state, you are aware, pay no taxes to the township or county, nor do they contribute anything for the support and maintenance of the roads. They pay their entire tax in the shape of a percentage on their earnings. The amount of money paid in by the railroads last year, as taxes, was nearly a million dollars. This is put into the state treasury. The people of the country naturally feel that the state has taken from them the power to tax the railroads, and all the benefits to be derived, so far as immediate neighborhood benefits are concerned. Now, if one-half of the money paid in by the railroad to the state as taxes could be applied to the public highways, could be applied to a good system of short roads leading from railroad stations, it would be a very satisfactory arrangement, I think.

I believe it would be satisfactory to the railroad company as well as to the people. This would not be contributing in the sense of the paper read here, it would be allowing a portion of their money to be used for an improvement that would be a benefit to them. Now the exact way to get at this is probably a problem for some one better versed in legislative matters than I; but I think it is an idea that would be the beginning of the making of a system of good roads, starting from railway stations and emanating thence. This would be only a commencement, but if followed year after year, would soon amount to

considerable in the making of good short roads, which would be, you might say, examples. The people would see the benefit of a good piece of road and get an idea of the cost, and be induced to continue these good roads as far into the country as was demanded.

I would have these roads constructed, if possible, under the supervision of the engineer of each neighborhood. I know it has been said that the opening up of a new system of roads would make a good deal of business for engineers; this may be true, but the railroad can lay out and plan this work a great deal better than any independent engineers could be deputized and made to do it. I think the railroads would take the contract for building these roads cheaper than it would be done by anyone else. The railroad would haul gravel or would take the building of the whole road upon itself, if the bill for so doing, properly audited and approved, would be received at the state treasurer's office as so much of their taxes. It is simply enlarging on the old system of a man working out his taxes, and I think it could be made to work.

MR. GARFIELD: I came here to listen; I knew you were going to discuss roads, and I am greatly interested, and I wanted to see what this body, that I feel has more influence than any other one body, would say. If I can say just a word to show my interest, that is all I desire.

The growth of road building in our country thus far is a work that has not gone very far, and still I am not at all discouraged about it. I am more encouraged to-day than six months ago. I felt when this discussion began to take its new direction during last year, that we were just about as badly off as we could be with regard to roads, and whenever the question as to the betterment of them by some local legislation, came up and was defeated, I felt we were in a discouraging condition of affairs. But after spending nearly five months on the other side of the ocean, and looking into their systems, I felt encouraged, because I found the very best roads I traveled over were begun 1800 years ago, were founded by the Romans in their progress north. The very best roads in Switzerland are on the lines laid out by the Romans and added to from that day to this. We haven't lived but a little while, and all Europe

is small compared with us, and if we can only get a start in this century I shall be content. I think what has been said about railroad building is true. Road building has had a set back from the rapid increase in railways. I was glad to see one thing in connection with Switzerland roads. Two faults with regard to Michigan road building have been, first, that we thought we had no good material to make roads of, and when we found we had, people did not take advantage of it and find the places where the material was in abundance. The very best roads of Switzerland are made of gravel—not McAdam, but gravel. It is such as we find in our drift, and it is drift material such as ours, only it is a little closer to the fountain head. In the streams running away from the glaciers, it is rounded off and left in piles, and you find quantities of about the same size, and they shovel that into their carts, and take it as they find it. We have the same material scattered all over the peninsula of Michigan, if we only find it; but the great mistake has been, even after they found these gravel pits, that they took it just as they found it, instead of screening it and taking only that which was best. The gravel there is screened. Here, if we find a gravel pit that has enough sand, we think we are exercising economy if we put it on the road with the sand in it, and we have a road not much better than before.

I once belonged to a little grange that was organized in our township, and we met at two little school houses. The road between those two school houses disintegrated our grange. It was too hard work to get over that four miles of road, and the result was our grange broke up just on account of that miserable piece of road between the two school houses. Upon the remains of that grange a gravel road company was organized, and they put a toll road by there, and there are two results of that road to-day. One that the property along that road for six miles, while other farm properties have been greatly lessening in value, has increased from twenty-five per cent to forty per cent. Then too, an example has been set with regard to the use of gravel. That road came over a hill made of gravel and sand, and no one ever thought it could be made a good road. It was the hardest piece of road in our county. All

this company did was to screen out the sand and they had a perfect road-bed. That single example was worth more in the road districts than anything that ever happened before. And so I preach, with Mr. Steele, the value of missionary work.

Just how, by legislation, to get those examples of excellent pieces of road before the people, I don't know, but it is the one thing of all others most needed. If we can get a single line of good road in every county, in every state, we shall have the whole thing settled, because we shall have everybody with us.

Six months ago, if anyone had said, "You will be a bicycler," I would have called him—I would have said he was very much mistaken. In the twinkling of an eye I was converted to bicycling; and there are lots of people to-day that are opposing any change in our system of roads, who stick and cling to that old path-master system, that will be converted in the twinkling of an eye, if you can just make a good economical road near them. I hope that whatever legislation we have, we shall not undertake too much, but get some object lessons before the people. That one thing will soon convert them from the most pernicious system that ever was. It was good in its day.

One other thing has occurred to me with regard to specific taxation. Now, the objection you will meet everywhere, in submitting any plan to the people, the majority of farmers will object to any innovation because they are afraid of an addition in taxation. I have met that everywhere. Now, if you can adopt a system by which they will get good roads and not pay any more taxes (I mean outside of the taxation they never feel), if you could show them that in a year they will not pay as much taxes as they do now, they will be willing to adopt any kind of system. That is why I like the idea of a state tax that shall be paid by everybody, rather than one paid by the farmers themselves. While it is true that the more immediate benefit is reaped by the farmers themselves, still every man that buys a bushel of wheat or a pound of flour will be benefitted by better roads, for immediately when you reduce the cost of putting these products in the market to a minimum, you are helping every man that has to buy, and there is no injustice in making every man bear part of the taxes.

Farmers do not realize as they ought, one thing. We must, in some way, turn the trend from the cities into the country. I think that that is the most important question before our country to-day, how to do it. The gradual decadence of agriculture in this country has tended to throw the people into the cities. Let us get them back again some way; and there is no motive power that will be stronger than the building of good roads and making country life attractive. The one thing necessary is to make country life attractive to people and they will go there; and one of the most essential things is the interchange of visits and thought. And just as soon as you get good roads, you will bring people together, and country life will be attractive.

In regard to specific taxation; it seems to me, aside from this one thought, making everybody pay their proportion, there may be something in the English system of taxation, special taxes for those who use the roads most—every man who goes over the road with a vehicle, whether wagon, buggy or bicycle, it seems to me can pay something for the privilege of good roads, in addition to that great number of people who simply get an indirect benefit. I am interested in this discussion, and in this earnest endeavor to get better roads, and I believe that the engineers of this country must do more than any other organization, because you know how to make a road and make it economically; and it is because your services have been neglected that we haven't good roads.

THE PRESIDENT: We are glad to have these ideas that Mr. Garfield has so ably presented, and glad that the farmers are taking hold of this question. The engineers of the state have understood the necessity for good roads for a great many years, but whenever they have attempted to advocate anything of the sort, it was thrown in their faces that they were simply looking for a job, but now that the people themselves are taking it up, we can hope for some legislation.

I have believed for many years, that the great evil of farming life, was the want of those social enjoyments which the human mind must have. It is that which has been driving all the young men and women from the farm into the city, and crowding our cities, and which is sending so many of our

farmers' wives to the asylum. Get good roads, and as Mr. Garfield says, the current will begin to set back. Men living now on small wages in the city, will go back to the farm, and have all the social enjoyments that he would have in the city.

MR. STEELE: I do not come here to discuss this question in any sense, as an instructor of the engineers of Michigan, as to road building. I come before you as one to lift up a voice in the discussion of the question as a matter of public interest, hoping that whatever our discussion may be, it will be conducted in that spirit which shall make it the most valuable and useful to those in interest.

It may be claimed that the engineers are looking forward to do something in their own line: Very well, if we do not tend to our own business, I do not know who will do it for us, and I want to state my position, not so much in the discussion of the law side of the question, which has already been mentioned, as the practical side. We are passing through, or perhaps commencing, one stage of education in road making—not exactly in road making, but a preparatory course for road making: We are not ready even to make the roads yet. Hence, the first thing I would mention is education. Educate everybody—talk it over, publish all you can about it, keep it going; if you do not succeed at one time, strike fire somewhere else, and persistently put this subject before the people until they rise in arms, and accomplish what we are after. I would like to have the determination of every member of this Society so fixed in that line, that no matter what discouragements are met, mis-legislation, or wrong course of action, they will still go on and accomplish the desired result.

The first thing I would put down is education of ourselves, and people in general. You may start out in the state of Michigan to-day, and ask those you meet outside of the cities—I say outside of, because usually in the cities they find the advantage of nice streets and pavements, which the rural communities do not have and appreciate, or think they cannot have, and you make a note of those men you converse with, and you will find the difficulty is, that they are opposed to any movement at all. They are afraid of everything—do not want to take a single step forward in this matter. You may present

an amendment to the constitution to-day, in the way of bringing this result nearer, and they will vote it down here in Michigan. Why? Because the people are not educated yet to see the necessity, or they do not fully understand the rut into which we have gotten. The education then should be begun of the people, broadening their views through our papers, through every channel, through the societies; and let me say right here, I have understood that some of the societies, or one of the leading organizations of the state have cast a reflection on the wheel men, saying that they were the prime movers in this work, and that the subject was not worthy of our attention, because of their moving first in the matter. Now this has come to me through good solid, straight-forward farmers. Wonderful, isn't it? I said to the man who told me that, "I would give credit to the d——l, if he only started people thinking about the system we have. I do not care who starts the subject if the ball is only set rolling."

Now we have another phase on this subject, not already mentioned. That is the need of the engineering profession to be prepared for the emergencies which they constantly meet. It has been suggested that our schools be transformed into great classes of students learning how to make highways; that we have schools of technology, with a special department which shall have professors etc., to illustrate how to make a good road. Now, I have no objections to raise for any such course that will more enlighten the people, because I have already planted one stake—my educational stake, but I say that it is assuming too much to claim here, in this early stage of the construction of roads in Michigan as they should be constructed, that the engineering profession that we already have, the gentlemen that I see before me at the present time, part of them, that we are not capable of taking the responsibility of road construction without more special education on the subject. It is rather a laughable situation, when we know that you gentlemen are engaged in the construction of all sorts of engineering works, railroads, bridges, tunnels and river improvements, and all classes of engineering work which tax the highest skill, yet it is suggested that the engineering profession needs special schooling to make a highway. I deny

the imputation. Is it not a fact? I will assert boldly that the engineering profession is able to take care of the highways, if only afforded the opportunity.

The next stake that I would plant most substantially and thoroughly, is for the location of the road. After having arranged all our preliminaries—how we are to get our money and change our laws—the next thing to do is to know how to locate the road, and that is just the very thing that we have not known how to do. I want to give a few of my experiences in locating roads.

In 1867 I surveyed the state road from Houghton to Midland. It was then a wilderness. We had to carry our provisions on our backs. Our whole expenses were to be paid by the counties through which the road was laid, and the bill would go before the board of supervisors. It started through Traverse county, and the county of Grand Traverse had to shoulder all the bills, as the others were uninhabited. It will be plain at once that the expenses ought to be kept at a minimum. When we came to a range of hills, we did not know which way to go without great inconvenience, but the order of the commissioner came, "Keep your line." We did so, and the state went to the expense of building a road over the hills, grubbing out the forest trees; and an almost impassble road it was, when created. After awhile a lumberman came in. He made a road right around the hills, and in about five miles came into our line, and the consequence was, he had a splendid road, laid on a grade that could take the immense loads that the lumbermen haul.

A few months ago I was called to lay a highway. I went south over an easy grade, and came within 133 feet of a quarter post. The petition was to go to that quarter post, and then turn east on the quarter line. The commissioner was very careful to require me to go to that quarter post. That stood upon a hill as high as this building; it was all a man could do to ever get up or down. But he wanted me to lay the road up that hill to the quarter post and then turn and go down. I said, "Why not lay it around here?" "Oh, the petition didn't call for that; I couldn't do it." Well, after arguing that question with the help of some men who were residents, he did finally decide to locate it around

the hill. I merely wish to show the folly of locating roads under our present system.

Location having been established, the next thing is distance. Distance has been cutting the first figure; it should not be so. We have been trying to shorten the distance, irrespective of grade or anything else; the proper plan is to transpose. Locate your line without reference to distance. First get a good grade, and then make it as short as possible in that grade. There are the two systems—the gist of the whole matter. We have been neglecting the one and observing the other.

The next thing to do in this state, is to have some one authorized, or some board of commissioners authorized, to re-locate roads that are already located or badly located—have authority to step right into a difficult place and say, "Here, gentlemen, this road is going on a grade around this hill, and you may say what you wish; we are going to take that land and put a road there. We are never going to spend another dollar on that hill."

The next stake would be on construction. We have been transposing; we have been trying to construct roads on bad locations. If we have good location first, we may make allowance for poor construction; but if we have a bad location, no good construction can ever accomplish what we want. I know of hills that they have put hundreds and thousands of dollars upon, and there are the hills yet; and I can stand upon the track and, without an instrument in my hand, mark out where I could locate a road to good advantage. I say every man ought to stand right up and put his shoulder to the wheel and say, "Stop, we have gone far enough!"

Another thing we are faulty in; we are not persistent in construction. We do not make it continuous and constant. We make a little effort during the season of the year when it is most convenient to make a road, and then drop it. I say, adopt a plan which will give a force upon a road similar to the way in which Mr. Sears puts a force of men on his railroad. Have a force of men to keep the road in order, to dig ditches so the water will run off. You know of many places where five minutes' work would save a great mud hole, if the work were only

done at the proper time. We ought to adopt a system which will give us continuous supervision and construction of highways, by a set of men specially employed for that purpose.

Another difficulty is this: We cannot carry our labor in one district over into another. Now, Traverse City, in which I live, is so situated that its highways are generally upon a level plain—a sandy plain needing only a gravel covering, and then we have an excellent road; but we cannot step over into our adjoining towns and spend any money; and if they have a hard place which they are unable to level down or improve, why, we have got to go over it. We cannot do anything to assist them. What I mean is to have it so arranged that appropriations of money can be made on roads, perhaps clear through the county or running out from the railway stations or county seat.

Another thing which we should encourage is the handy curve already mentioned; and in locating roads, to secure easy curves. Did you ever notice how easy it was to keep a road in repair at a corner where an easy curve was turned? Almost every one that I can think of, where an easy curve is made in the road, always has a good track. I want to enforce that idea and apply it in the location and construction of our roads—easy curves instead of abrupt angles.

Another difficulty in road construction is that the engineer is entirely eliminated from the question. We have been going on the plan that we did not want any engineer. We get him simply to give us a sight through a compass and then let him alone. I had no rights on that day when I had the confab with the commissioner; I ought to have kept still and let him locate that road over the hill. I say that we have eliminated the engineer, and I want to rise in my might and say, "Let us come up and take the fort." It is time for the people to rise and demand recognition. We have been absolutely kept out from first to last. The application for the location of a highway—the authority in that is confined exclusively to the highway commissioner. There is not a man in the state of Michigan that can say "no" to the highway commissioner. His location cannot even be altered by the board of supervisors. There is not a man in the township

where he lives that can say anything; there is no check upon him. Isn't it a good principle, when you have a man handling money, to have someone else to keep check upon him? I think so.

One more point I want to raise, and I am through. It has been suggested by one of the regents of the university, or one who has held the office of regent, in my conversation with him on the train coming to this meeting, that it might be a good plan to so arrange our engineering courses in the Agricultural college and the university, that a good many of these things that we require of an engineer could be accomplished through the information of these young men and their able tutors. That is, to put into actual practice the ideas that they are taught there, and let them to some extent, through the years to come, go out here in the state of Michigan and do this work. This gave me a new idea, and possibly it may be of some value to adopt a plan by which in the making of estimates, in the location of grades, setting of stakes, watching construction or carrying forward of large contracts, that these men can give us valuable assistance without extra expense. They would be pursuing their instruction under the guidance and control of their professors.

Mr. Teed: We built a road last year; and I thought I would tell you how we built it and what it is worth. But as Brother Steele remarked something about the county surveyor it made me think of something I want to say. I want to tell you about the county surveyor in our county. I was away last week, and when I got home, there was a great rush and hurrah. They wanted to find the county surveyor, and everybody I met told me the supervisors wanted to see the county surveyor. I went up; and the way they shook hands! I got an idea in my head that I was the most important man in the county. They stated their business and we transacted it in a little while. But this idea still clung to me, and I said, "I have been county surveyor for twelve years, and when I serve this term out it will be fourteen. Now," I said, "I never asked for anything yet, and seeing I have to keep the records, and seeing I had to buy the safe to keep the records in, and had to rent an office to put the safe in, that I would ask the county to pay

one-fourth of my office rent." They almost fainted away, but when they got over it, they began to laugh; and when they did, I said, "Gentlemen, it wasn't anything but a joke."

Well, we built last year about eight miles of what we called a boulevard. Of course, as it was built outside of the city, the money was all raised by private subscription. It was built around the shore of the lake. The only soil was this light sand. We surveyed the road just as if for a railroad so far as crooks and curves were concerned, but then the question was how to get the gravel? Now, it has been suggested by one or two persons that in a great many townships there wasn't any gravel, and in a paper read this morning, a means was suggested to get the gravel. Now, the gravel over half of that road was hauled ten miles and it did not cost much. One of the logging roads, extending out of the town ran through an excellent patch of gravel. It had gravel and clay, just the right amount. Now, they took light iron and laid right along this track, and went up into the woods, hauled the gravel down and dumped it. When they got the gravel the whole length of the road, they pulled the track up, and put the gravel in the middle. This is a good gravel road, and there was no gravel to be gotten within a good many miles, and yet it was not very expensive. When we built on the south side of the lake, they adopted the same method, so far as putting it on the cars, but there was a gravel pit right at hand, and they didn't sift the gravel, one part gravel, two parts sand, and they fixed the road on the south side of the lake. But that never has packed and never will pack if left alone; and they will have to fix it just as we re-gravel our roads in town. The way we did that, we got the road-bed prepared all right, and then spread that over with three inches of clay. We then put on four to six inches of of gravel, according to the amount of travel, and if the sand was sifted. Of course, if sifted, it would take less gravel and less clay; first three inches clay and then five or six inches of gravel. That packs down and makes a road as hard as a stone. We found it cheaper to put on the clay than to sift the gravel.

The way we came to do it was this: The people that built the first streets in the town said, "We want to make this road

so that the rest of the people will catch the idea and build their roads right. We drove stakes twenty feet apart, up the line of the street, and four rows of stakes—drove them down to where we wanted the sub-grade, and then put an assistant of mine to work right along with the contractor. He put strips three inches wide and filled the clay up to that. Then he put small stakes down, that would come to the top of the clay, and put on his strips five and six inches wide, and then filled the gravel to that. When finished, we had just the amount of clay and gravel that we needed. This year the question came up of building some more roads, and some of the council objected. They said, "We have a city surveyor; let him stake it out and take his levels," but they didn't think it would pay to put a man on there to work right along with him; but, of course that question was argued, and the system we have is to have this man work right along with the contractor. He sets the stakes in the first place, and has them to work from, and puts just so many inches of clay and gravel.

Now this boulevard—the part that didn't work. We have got to take a scraper and go through, and throw the gravel out to the sides, and then go and put that clay in, and then throw the gravel back, either with the scraper or by hand.

Mr. Hodgman: I want to make a suggestion: We were to leave the question of construction until after we had the papers on that subject, and instead of discussing the question how to make roads, first get at the point of how to improve the laws. I would suggest that we appoint a committee of three to collect the points upon which we seem to be agreed as to the way our laws should be amended, and to collect and codify them.

Mr. Appleton: I would like to know if the gentleman's idea is, to have the committee collect and codify from the whole mass, and submit to this meeting before it adjourns? Won't the time be a little short?

Mr. Hodgman: I don't know as any committee could, during this session, codify these statements. My idea was, to select the points, codify them—those that we seem to be agreed upon, print them, and send out to members who are

not here for their suggestions, and then place it before the proper authorities.

MR. CHURCH: I wish to say just a few words that Mr. Steele's remarks suggested: We sometimes succeed in getting the commissioner to locate the right road, and then find in a short time, somebody's land is taken. He works by some hook or crook to get the commissioner to take up that road and put it over some hill, and it is done. A good location and money as well, lost. When the road is well located, it should be out of the commissioner's power to easily move it.

MR. STRONG: As to the change we want made in the law, it seems to be pretty well agreed, and it is the opinion of those who have looked the matter up, so far as the law is concerned, that the probabilities are, that we will not be able to make any radical change in the near future. Isn't it wise then for us to try and make a bridge for ourselves? In this matter of roads, if it is probable that we cannot accomplish what we would like, isn't it wise for us to study more particularly on what we can do at the present time to improve the system we now have, so as to make it answer temporarily the needs and purposes of the public generally and the farmers, and yet flatter their prejudices, and yield to the opinion which probably will be the opinion of the state and of the legislature, so that we can accomplish almost what we want at present, and some day, accomplish all that any of us imagine.

It is possible for us to improve the system we now have, and I have simply given this as a matter of suggestion.

MR. HODGMAN: I want to speak a few words more, regarding the point I presented this forenoon. It was right in line with the argument presented by the last speaker. I believe that we are to be compelled to use our existing agencies to a great extent; I myself have very grave doubts as to the results of putting any constitutional amendment before the people. The people in the state of Michigan have got in the habit of voting down constitutional amendments. I believe, that under the plan I presented, we can have our road laws improved, without changing the constitution. We have tested for years and years, the plan of the mill tax for the support of our public schools; I believe a similar tax for the support of our high-

ways can be made by the legislature. I think without any constitutional amendment we can put an end to the present want of system of work on the highways. I don't know of a man who would not say, that with money to work on a road, he can do four times as much as is done at present. I believe the people of Michigan are willing to abolish the present system of laboring on the highways; our legislature can levy the tax without a constitutional amendment. I think we can make use of our present highway commissioners, and by having a Board, for the purpose of reaching the roads that concern the people of more than one neighborhood, make at least a good beginning without any constitutional amendments. Now, the best thing I know of in the way of an education, is a good piece of road in a neighborhood. I think we can start the matter right now, and my plan, I think, is feasible.

Mr. Bailey: I move that a committee of three be appointed to draft a bill to be presented to the legislature. I think that is the right thing. We might talk for four weeks or four years, as engineers, and the gentlemen sitting up in that big building to-day, if we were to present a bill, would sit right down on it.

Now, I move that a committee of three be appointed to draft a bill to be presented to the legislature, but that bill before it is presented, should be submitted to every member of this organization for his suggestions.

Another thing—I propose that we have two engineers and one granger, and we have a granger right here. He represents a good many thousand of the best farmers in the state of Michigan, and I know it. I would like to see one granger put on this committee, and two good engineers of this Society.

Mr. Appleton: I was talking with Judge Black of this city on my way home from this meeting, and he tells me that so far as the constitutional convention is concerned, that some of us have thought might be held, that it cannot be, and I believe he emphasized it by saying, that there was no question about it at all. The vote in the state must be in proportion to the vote cast for the members of the legislature, which it in no way approximates, and I think his view of the case is entitled to weight; therefore in view of that I think it would be unwise

for us to spend a great deal of time upon a measure that will need an amendment to the constitution. I think it will put it too far off, and so far as the road commissioner is concerned, I am perfectly willing to leave it to the committee.

It has been suggested by some one, that a committee of three is hardly enough, but the difficulty I have always found is, that the committee never all come. I think perhaps five might think of more good than three, if they would work, but if we were to talk here for ten years, you would have to leave it to a committee to suggest to the legislature, and that seems to be the only way to amend the present law. Whatever you do will have to go in the shape of amendments to the present law. I haven't a particle of faith in the ordinary road commissioner. The township of De Witt I think, appropriated the sum of $500 for the benefit of the roads, and they specified two particular pieces of road that should receive the benefit of the $500, in sums of $250 each. Of course, the commissioner went on and expended these sums. The only difference now, and before the commissioner put his $250 on the piece, is that it is infinitely worse now than before, because he drew worse stuff on the road. The people of the township are disgusted, and probably will never appropriate another $500 to be fooled away.

But I think a committee will have to be employed to select the most harmonious suggestions and present them, whether to each member or not—perhaps that is the best way, but I am certainly in favor of the plan, and I think the allusion to Mr. Garfield is good. I think perhaps we might adopt the suggestion made, to have five members of the committee, and thoroughly impress upon them that they should meet with the first named who may be the chairman, and then look this matter over, and get it before the present members of the legislature at as early a day as possible. So far as this road making is concerned, I know some of the best engineers who are the poorest road makers.

Mr. Steele: I think it would be decidedly out of place for the Michigan Engineering Society to go to drafting a bill to present to the legislature; but it would be very much in our line of work to offer a suggestion, either to the proper com-

mittee of the legislature or to the committee on public highways, which would embrace our ideas as practical engineers interested in this subject, in a brief statement of what we believe would be for the interest of all concerned. And I certainly would not reflect upon the ability of the members present, by saying that they are not able to draw such a statement of their views—I believe in going at it, doing it, and having it done. There is no reason why, before we adjourn, if we keep in session part of to-morrow, that we cannot do it.

I make a motion to this effect; that this Society before it adjourns, shall, through a committee, appointed by the chair, consisting of five members, embody its opinion on the subject of road laws, and present it to the highway commission, or to the proper committee of the legislature, as they may deem best.

MR. SELLERS: I support Mr. Steele's motion.

THE PRESIDENT: The question before the Society is, shall we, before we adjourn, appoint a committee of five members through the chair, to draw up an expression of the ideas of this Society with regard to the road laws, and present the same to the legislature?

MR. SELLERS: Are we as a Society, sufficiently well founded in our own minds, to have this committee, in so short a time, suggest anything but what would be susceptible to a great many amendments in the legislature?

MR. HODGMAN: I think we are very nearly unanimous on the important points. I have been greatly surprised that people coming here from different parts of the state, who never had any correspondence with each other on the subject, seem to be so nearly united, and I think great good will come out of our getting together and appointing this committee.

THE PRESIDENT: Are you ready for the question?

The motion seconded and carried.

THE SECRETARY: Mr. Appleton referred to bad work done by a highway commissioner in Dewitt. The other side is shown by the following report, and remarks by T. O. Williams, which came into the Secretary's hands since the Annual was in press and is inserted here in connection with the discussion:

HIGHWAY COMMISSIONER'S REPORT.

ALLEGAN, April 3, 1893.

To the Township Board of the township of Allegan, County of Allegan:

The following is the annual statement of the commissioner of highways, of the township of Allegan, in said county of Allegan, for the year ending April 3, 1893:

The improvements which have been made on the roads, culverts and bridges are as follows:

Expense of building culvert in Rossman's ravine, size 66 feet long, 10x12 feet inside	$1,329.06
Expense of building Kellogg culvert, size 66 feet long, 12x12 feet inside	1,698.92
Repairs on the Maskey culvert	45.80
Repairs on approach to Allegan bridge	68.21
For plank for Littlejohn bridge	55.45
Repairs on Eagle foundry bridge	11.15

South Watson road—three-fourths mile, graded and graveled at a cost of $459.63
over and above about $500 worth of team work donated.

North Watson road—about one hundred rods graded and graveled at a cost of $424.09
over and above $200 worth of team work donated.

Road running north from Greitzinger corners, one-half mile graded, eighty rods graveled at a cost of $477.33
over and above $200 worth of team work donated.

Road running east from Wetmore's one-half mile, graded and nearly graveled at a cost of $149.68
over and above $200 worth of team work donated.

Monterey road—sixteen hundred feet of road graded and six hundred feet graveled at a cost of $542.79

Dumont road—one hundred and forty rods graveled and other repairs made at a cost of $252.15
over and above $300 worth of team work donated.

Cummins road—work done at a cost of	$175.11
State road—work done at a cost of	116.45
Job let	400.00
Cheshire road—job let for	182.50
Saugatuck road—repairs done at a cost of	49.16
Mill Grove road—repairs done	34.44
Kellog hill—repairs done	71.56
Otsego road—repairs done	9.93
Sherwood & Griswold for lumber	72.04
Turner and Renihan—for hardware	29.83
Roscoe Ellis—to apply on job on Wilson hill	50.00
John M. Heath—for plow fixtures	7.64
Thomas Stewart—for plow points	3.45
Snyder & Brown—blacksmithing	1.50
Road scraper blade	8.00
For tile used in the various districts of the township	287.72
Total expenditure	$7,013.62
Amount overdrawn	13.62

More money was necessary to be used than was raised at town meeting, which was $7,000. I would recommend building a culvert on the Dumont road near William Barnes, as the bridge there is in bad condition.

I would further recommend there be $3,000 raised for highway purposes to be used on the roads, where the people will donate sufficient team work to draw the gravel.

CLARK COLLINS,
Highway Commissioner.

Roads in our town are so well built that the item of repairs is very light. The first permanent road, built about eight years ago, has sustained an immense travel and, with the exception of a few loads of gravel placed in the worn out places and a general surfacing up with the road scraper, there have been no repairs.

The roads are very permanent with 8″ to 12″ of gravel on the subgrade. The per cent of grade is established by the township board. The people are very well satisfied with the returns from the money, and at this last town meeting they raised $3,000 by vote, and the town board have the right to raise more and probably will, so as to make two or three miles of road this summer.

THE PRESIDENT: You are all aware, that some time ago, Governor Winans appointed a committee to investigate the subject of road laws, and they have made a report which must largely govern our deliberations. I am pleased to know that one of the members of that commission is present, and we would be very glad indeed to hear from him, especially with regard to the defects which the committee found to exist in the provisions of our constitution.

MR. KINNANE: I feel assured that anything I might offer would not be of much interest to this Association, along the line of road making. Through the courtesy of the Secretary of this Association, I have come here for the purpose of observation and reception, rather than to offer any exposition along the lines of the general subject. I have, however, some views in regard to the legal obstacles of the question —or the problem, as it now stands.

Together with the other two members of the committee, of which I had the honor to be one, the legal aspect of the matter was considered at several sessions, and the two great requisites seemed to be, that there shall be a somewhat revolutionary system of legislation adopted, and somewhat after the fashion that the board of supervisors took. The several counties are hedged in by constitutional environments, so that it may be said, that the whole system of township commissioner and path-master is hedged in, so that it is practically impossible to make much of an inovation upon the present system, without a constitutional amendment.

You will recall, undoubtedly, because it is a matter of special interest to ourselves, a case that went up from Saginaw county, where an attempt was made to lay out a system of expenditure on county roads, and it was held that it was an invasion upon the prerogatives and the constitutional power of the highway commissioner, and the legislation was held invalid, and the tax levied in consequence not collected.

There was a commission constituted up in Bay county—what is known as the "Stone Road Commission." They have built, as I understand it, nearly fifty miles of stone roads, and made excellent progress; but their system has only worked because of practically unanimous acquiescence, because it stands upon the same basis that the Saginaw scheme stood.

So I see that the first obstacle which confronted us, was the necessity for a constitutional amendment that would do away with the powers of the present township highway commissioner. In other words, that would give the legislature power to accomplish that. Of course, we did not go beyond a mere general statement, for it is simply a matter of engineering skill to carry out the details of any plan.

Our idea was this, that a system of county roads should be laid out—that is to say, the main highways, extending to and from the county seat—that it should be under the control of a board of highway commissioners, to embody five, in our proposed amendment, five commissioners to have general power to lay out and discontinue and do everything else in the way of road making upon the main highways of the county that was necessary; and also we embody the idea of special assessments to some extent.

That is the way the matter stands. If anything is done in the way of a general plan that can be developed for a period of years, upon some enlightened scheme of engineering, it seems to me that it will be absolutely necessary to have a constitutional amendment in order to do it. You cannot get rid of the arbitrary power that is given the present township officers now without it. You must draw the teeth of the highway commissioner's power as they now are, before you can accomplish anything else.

I have felt some encouragement from what I have heard to-

day. Coming with the idea of listening, I believe I have more practical information upon the general subject than I have been able to get in some months of desultory reading; and what I hope for now is this (and I believe I speak the sentiments of the commission), and that is that possibly through the interest of the engineers and the bicycle clubs, and such others as may take a general interest in the subject, that a constitutional amendment may be submitted and may possibly be carried, although that would, on the face of it, look like a bad probability. The hope of the whole matter would lie in its being pushed in special interests. It has already been intimated that the farming community, for whose special interest the whole matter will ultimate, will be just the ones to get the idea in the first place that there is a possibility of extra taxation, and when they have that idea, you cannot dislodge it, and there is no room for another; and if they vote at all, they will vote it down. So there is abundant opportunity and neccessity for missionary work, and an intelligent discussion of the matter from a practical standpoint will possibly facilitate the passage of the amendment. If the amendment is passed, there will be a bill introduced so that legislation may be had at this session; after the constitutional amendment is passed, if it shall be passed, and the amendment that we have submitted or something in the nature of it, will clear the way for such legislation as will facilitate and make possible an enlightened plan of systematic road building that will be somewhat of an innovation on what we have been doing, under the path-master system.

I tender my thanks to the Association for their courtesy.

The President: Do you know whether this proposed amendment has been introduced into the legislature?

Mr. Kinnane: It was submitted with the message of the out-going governor, and the report now is in the hands of the proper committee, and I think nothing has been done. It will be submitted without doubt. The amendment covers quite a little ground, and it seems to us necessary, in order to accomplish needed results.

The President: It seems to me that one of the most effective things this Society can do, will be to pass a resolution properly drawn up, petitioning the legislature to submit this

amendment, or something, such as their judgment shall dictate. I am confident that these gentlemen have examined into this matter thoroughly and know just what they are talking about; and so long as our constitution is in such a condition that we cannot modify our present system, it is a waste of time for us to talk. I do not believe we can ever get good roads so long as we have the present system. You cannot get men fit to build roads, to serve for $1.50 or $2.00 a day.

MR. ALBERTSON: It would seem that it would be necessary to have gravel beds in order to make very much improvement on the roads, whether under the present system or a modified one. And wouldn't it be well to provide that the township could own gravel beds, with a right-of-way to them, and the right of condemnation? That can be done under the present system.

MR. KINNANE: I presume that can be done.

MR. BAILEY: The words just spoken are good. Two years ago I had occasion to look up the road law, and I will simply say here, we haven't a road law in the state of Michigan. If there is any gentleman present who has been highway commissioner, he has probably taken his level and gone on to some hill and set his grade stakes, and about the time he got his team there, he ran against a stump; nothing more nor less than, as the gentleman says, a farmer who had got an idea it was going to cost him something, and away he goes to the county seat, gets an injunction and a man with a high collar on, and I have to—whoa! This is an actual fact, and it has actually transpired within eight miles of this big city.

As the gentleman says, if we have a road law, it should be a radical one. I tried my best to get that right-of-way. I could not get it of him, and I say to-day that you cannot work the public highway in the state of Michigan without laying yourself liable to charge of trespass, and they will sustain an action against you every time, unless you get the right-of-way in proper shape.

I had occasion to look up this law with as a good lawyer as the state of Michigan affords, and he said that under our present law it seemed impossible to do anything upon the public roads. And if the people vote to revise the constitution, I hope

whoever is appointed will see that a proper road law is put in, so that if I am highway commissioner again, I can level and grade my roads. I have been path-master in my district eleven years, and I never worked on a road without setting grade stakes, and the wheelmen always like to turn into my house and get a drink of water at my well; they want to shake hands, and they say, "Mr. Bailey, who built that road along here?" I have made a trotting course there, a mile long. It was used and is used for a trotting course, and it is the only good piece of road between here and Eaton Rapids, if I did help to build the state road.

If we can get the grangers to move in this respect, they will carry an immense amount of influence towards getting what we want; and if we can get them waked up to this idea, we will get some help, because they are the wealthier part of the farming community. They are the lettered part—men who read and study.

Another thing I wish to speak about: why I spoke of Mr. Garfield. He belongs to the state horticultural society. That is a large factor. This society, or the off-shoot that I belong to, for the last five years has talked nothing but roads, laws for better roads, and the ways and means to make them so. You see, the people are getting waked up about roads, and I hope this thing will be brought to a successful issue. I do not think anything will be done this present term, but I do think when our constitution is revised, and the necessary incorporations made, that we can have good roads.

The President: Any further remarks on this branch of the question, The Road Laws? If not we will proceed to the papers on Road Construction.

Mr. Steele: In the discussion of this subject, we have been governed by the sole idea that we were going to make a dead sure thing of a new plan in the system of highway construction. Now, from the report of this gentleman, we are led to understand that there is an insurmountable obstacle in the way. It occurs to me that I would like to call upon any gentleman present to give his views, if he has any, or turn it a little the other way, ask if any gentleman present knows why the legislature of Michigan, now in session, hasn't authority to pass

a law to restrict, enlarge or control the present highway commissioners of the state of Michigan?

MR. APPLETON: I know no one better qualified to answer the question than George E. Steele, of Grand Traverse. He has been looking up the law a little.

MR. STEELE: I have read enough to keep out of jail so far. But I am one of the kind that doesn't believe in backing down. When you get started on a right thing, or a thing that is going to be right, push it on. I am sorry to see that Mr. Kinnane has gone; I wanted to ask if the commission had considered that question, whether in the event of failure to pass such an amendment, they had considered this question as an alternative, until the other can be brought about, whether we could not make such a change to great advantage.

MR. HODGMAN: I think he made the statement that we could. I wanted to suggest that what I said this morning was with that directly in view. Very likely we shall have to keep the highway commissioner, whether we want to or not, and I made suggestions for the purpose of controlling the highway commissioner. I believe that the highway commissioner is just as much subject to the acts of legislature as any other member of the township or state. That highway commissioner can be controlled I believe, and my whole scheme had that in view. I believe we can put the whole thing right through our legislature without changing the constitution at all. If we get a real good man for highway commissioner, the chances are the people will continue him in office. My whole scheme is with the idea in view of the constitutional amendment failing, and that we should do the best we can with the means at hand.

MR. RANDALL: I think that every session our legislature has been trying to control this same highway commissioner. I believe it is about all lost. I find a great many things in our present road laws, very good limitations on this highway commissioner, all having no effect whatever. It says among other things that the ditches shall be at least ten feet from the center of the road, and that improvements of the roads shall, as fast as practicable, be made with gravel. It goes on to say a great many other things, and if the commissioner followed the law, pretty good roads would result; but this road business is under

the control of the highway commissioner, and when we start to institute any changes, we fail every time; and when we enact laws and try to control him, he does not take the trouble to read them.

We had some trouble in a township adjoining us, where they were going to build a road to our town. We were very much interested in this road, because we wanted the people to come down and trade with us. I asked the commissioner about his specifications. He said, "I am going to turn-pike that whole business. I am going to have it fourteen feet from the bottom of one ditch to the bottom of the other, and have the ditches two feet deep below the natural land, before it is graded." Well, we got to talking about it. We didn't expect to make any suggestions; we thought, though, if he built such deep ditches as that and then drew up his grade, it would make the road pretty narrow, and we thought it ought not to be less than twenty feet wide.

"Well," he says, "I cannot help that, and I think I know how to do this business." It happened that a few of us fellows got around and said: "Mr. Commissioner, there is the law, and if you don't follow it, we will make you sorry," and we got him to change his specifications. Not because the law was there, but because there were a few determined men. I have no faith in this highway commissioner system. Let us have some good roads; I do not think we can do away with the commissioner, but let us have a county system in addition. The gods themselves cannot take back their gifts; we have put this matter in the hands of the road commissioner, and we cannot take back the gifts we have given him. Let them have their township roads, and have them just as muddy as they can, but let us have some county roads.

Mr. F. H. Williams: I think the subject of this discussion has come down to two points—education and legislation. I believe that under our present system, we can go on and improve our roads, and make good highways. I know it can be done. In our own township, one or two men who were up in the business, and knew what good roads meant, insisted we should have half a mile of good road. That one half mile was built. The next year, the farmers of that community and the

business men, turned into our township meeting and voted $1,000 for the further improvement of that road. It was done. Next year we had a vote of $2,000, and during the last six or eight years, the appropriation has amounted to between $20,000 and $25,000, and now we have twenty miles of good roads. Put a good road beside a bad road, and the difference will be appreciated. If you will try that once, yon will see the good results.

How can we control the highway commissioner? Simply in this way. Elect a good man. Second, have him required, before he puts one cent of money upon a road, to have a survey made by a good engineer. After you get the plans and specifications, have the commissioner follow them out, place a penalty that he will suffer if he does not, and I think under that plan, and with that system, we can make what we already have, answer. What cannot be cured must be endured, and I think we have a system which we can adapt to good roads, and get good results.

THE PRESIDENT: If there is nothing further to be said on the subject of road laws, I think we had better proceed to the reading of papers on road construction.

STONE ROADS IN BAY COUNTY.

H. C. THOMPSON.

In 1880, the board of supervisors conceived the idea that the highways should be improved permanently, and set themselves at work to formulate a plan for so doing. A proposition to raise one hundred thousand dollars on the bonds of the county was submitted to a vote of the people, and was carried. Committees were appointed by the board of supervisors to visit localities where permanent roads had been constructed, and work was begun on several of the main thoroughfares.

There being no suitable material in the county for constructing the roads, stone was procured in Ohio, and conveyed by boats to the Saginaw river, where it was placed on docks and drawn by teams to the respective roads.

The Ohio stone, not proving satisfactory—being too soft, a better quality was obtained on the shore of Lake Huron at Bay Port, where it was loaded on cars and conveyed by rail to its destination. Considerable gravel was used in the construction of the roads at different times, and this was procured from gravel beds near Mason. All the material used had to be imported, thus making the cost considerable; but the result of having good roads at all times of the year is shown in there being a uniform price and market for all farm products, and never at any time is there a scarcity of any of the necessaries of life, on account of bad roads.

The soil is a sandy loam, and the surface practically level, raising about three feet to a mile from the level of the bay, which affords sufficient grade to convey surface water through artificial channels. The first object to be sought was drainage, and this was accomplished by constructing suitable drains on both sides of the grade. An excavation twelve feet wide, and about one foot deep was then made on one side of the grade to receive the first layer of stone, which was composed of the larger stones, laid flat with edges close together. This foundation would averange four inches in thickness. Upon this layer was placed stones of smaller size, and in the early part of the work the surface was made smooth by pounding with hammers, until the stones on the surface would be about one and a half inches in diameter. Later, the top dressing was put on entirely with crushed stone. Gravel was also used as a top dressing, but this was so easily displaced that the crushed stone was adopted. There was no roller used in compacting the stone or the sub-grade. On this account a great many of the stones would be displaced by the traffic, and it would require some time before a uniform surface would be made, and this not until the ruts made by the wheels had been filled by raking in the loose material. A road machine or scraper has been used to do this work, with good results. The first few years the practice was, to make the width of stone twelve feet, but later nine feet was adopted, with a margin of two feet of earth on one side and eleven on the opposite, making a road bed twenty-two feet wide.

This has proven to be of sufficient width for all purposes. The surface of the road has a crown of one foot, and the stone work a crown of four inches which soon wears down level, and after about three years use, requires a top dressing of fine broken stone, to fill up uneven places. The depth of material laid loose, was twelve inches, but when compacted would not be more than eight inches. The stone costs delivered on the railroad, about $5.80 per cord, which would lay about three rods in length, The earth work, hauling and laying the stone was let by contract to the lowest bidders, and varied from $1.60 per rod where the material did not have to be hauled more than one-half mile, to $5.50 per rod where the distance was five miles.

The act authorizing the issue of bonds, also provides that a sum not exceeding two mills each year could be spread upon the cities and townships, included in the stone road district, and the money thus raised, about $30,000 annually, could be used in extending and repairing the roads, which has been done each year, until there are at present, about fifty miles in good condition. The supreme court has decided the tax to be unconstitutional, in that a tax could not be levied in city or town to maintain roads in another municipality. This will end the further extension of the roads, and it will be doubtful if the several townships through which the roads extend, will be able to bear even the expense of keeping them in repair, the cities having paid about nine-tenths of the whole amount expended.

The average cost has been about $6.00 per rod, and I think about thirty cents per rod would keep the roads in good condition.

MR. ROGERS: This question of cost, is something the farmers are very anxious to learn about.

MR. BAILEY: My paper has had all the wind taken out of its sails. If anyone would like to know how I would make a good road, I could tell them in about five minutes.

MR. STEELE: That is what we are here for. If you can tell us in five minutes, we would like to hear it.

HOW TO MAKE A GOOD ROAD FROM THE MATERIALS AT HAND.

M. H. BAILEY.

First survey, level and cross-section the road, noting carefully every water course and depression where water is likely to run or stand. Draw a profile of the work, giving exact grade line of road-bed, depth and width of all cuttings and fills, grade, depth, and size of all water courses, culverts and sluices, natural and artificial, that will be necessary to properly drain the road-bed. Cross-section the road every sixty-six feet, setting stakes for outside of cuts and fills.

Get the right-of-way, if you can, for the improvement of the road and water courses, from the land owners. If you cannot get the right-of-way from them, the statute points out the manner of proceedure.

The right-of-way secured, you are ready to commence work. First excavate your ditches and clean out the water courses. Put in the culverts and sluices; make the cuts, fills, culverts and water courses exactly to agree with the profile; call on the engineer to examine the work and see that it is correct. If pronounced O. K. you are now ready to commence work that twenty-three out of twenty-five individuals will call you a —— fool for doing. They don't know that earth is a sponge and must be made very fine in order to pack down hard. Have a good plow that will easily reach a depth of ten inches. Set it so that it will get there; put on team enough to go along easily. Start in the center of the road; start a subsoil plow in the same furrow that will go six inches deeper than the surface plow, so as to thoroughly break up the road-bed sixteen inches deep. Back-furrow in this way until you have a road-bed broken up thirty-four feet wide. Have hands enough to pick out all the stone, depositing them on the side of the road where they can be handily got by wagon or stone boat, to be placed at the foot of the embankment or where they will be out of the way and not likely to get in the track again. Hitch two good teams onto a good forty-tooth

spike harrow and harrow the ground thoroughly, picking out all the stones. Back-furrow the road to the center again with furrows eight inches deep and six inches wide; back-furrow the road-bed thirty-two feet wide; harrow thoroughly and pick out all the stones as before,until it is as fine as a garden bed. Plow it again commencing three feet out from the center and back-furrow thirty feet wide; harrow it again thoroughly. You are now ready to use a good road grader. Set the ditch end of the blade as low as you can and the road end as high as you can. Go over the track twice, the last time only cutting off the knolls and hummocks that were left the first time over. Clean out your ditches with hand shovels. Now set the blade of the scraper with the ditch end an inch lower than level and the road end an inch higher than level, ditch wheel of scraper three feet from center of ditch. This will level the earth very good. Now set the scraper blade level and square across the road, and drive in the center of the road. This will leave a ridge at each end of the blade; set the blade so as to just level the ridge. The center of the road will now be five inches higher than the grade, six feet from the center four inches higher than grade, at ten feet two inches higher than grade, at thirty feet twenty inches below grade or twenty-five inches below the top of the road. This is just right for a good earth road, and in first-class shape to make a foundation for a gravel road. Now roll the road-bed with a light roller, not less than four feet in diameter, and keep on rolling it, weighting the roller until the ground will not crowd under a weight of 10,000 pounds. If the earth is damp enough, this will pack the road-bed hard enough.

For a first-class gravel road put on three inches of screened gravel nine feet wide and roll it down hard. Put on two inches more gravel eight feet wide and roll down hard. Watch for ruts or abrasions of the covering, filling them promptly, and you will have a road that will last for twenty years as an earth road, or fifty years as a gravel road. On washed sand like that at Sand Pier and along the shores of Lake Michigan, I would not waste time fixing road-bed, only to bring it to grade and put in culverts and bridges, but put the gravel in just as it comes from the pit, four inches thick in the center and ten feet wide. Roll it down hard and then put on more gravel four

inches thick in the center and two inches at the side and roll it hard. This will make a road that will carry fifty teams a day for twenty-five years at a cost for repairs of one mill per mile per annum for each team or $18.25 a year.

MR. ALBERTSON: In case the center of the road is good, what is the object in plowing it up, and disturbing it?

MR. STEELE: I want to compliment Mr. Bailey, so far as relates to the road bed foundation, the work being thoroughly done, it prepares for a drainage which no other system can equal, and that is the first thing for us to look after; but there is one difficulty in the way, and that is, he is working upon a class of soil that will make a road bed; often we have to contend with a soil, that after all the preparation, is no good whatever. After the preparation outlined in this paper, it is no better than it was before. I refer to light sandy lands. We have thousands of miles of that kind of land in Michigan, and the more you plow and harrow it, the worse it is. For the lighter lands, my experience has been, that the best thing is to prepare a narrow way by smoothing it off, and then putting heavy materials on. We practice it in the Traverse City country, and with good success.

While I am on my feet, I want to give an example of the success we have had in Traverse City, in a way that we didn't expect. The road was built about seven miles, over this light, sandy land, and before the work was done it was almost impossible to get a load through there, the wheels cut so deep into the sand. They made a contract—three townships went in together, to build a stone road about five feet wide, covered with clay and gravel. The stones were obtained in the immediate vicinity of the bay, and brought on scows, and only required a little transportation. These were laid, and most of the road was constructed in the way I have said; but the fall of the year came and they couldn't get the stone on the scows to build the road, so there was a strip of about half a mile, for which it was impossible to get the stone. So they raised the question of what to do. Finally, they decided to fill it in with gravel and clay, and then gravel again. Now, by simply following the road back into the hills, there were great quanti-

ties of nice gravel to be obtained. So they made this portion of the road, connecting the two that had been built of stone, with a foundation of gravel and clay, and gravel above, and to-day, that portion of the road is best It traveled better, and it was less expense to keep it in repair, and it has really stood the heavy traffic of that country—which is immense, much better than the stone foundation. The difficulty with the stone foundation was, that the big hard-heads that they put in, would gradually appear in the surface of the road and form obstacles, and the wheels would cut into the sand.

Now, that is a demonstration of just the point I wanted to enforce; that we have here, in unexpected places, and accessible, materials out of which to make our roads—good gravel, and perhaps a little clay, although I would put in very little indeed, and if you have a certain class of gravel, which packs well, it is well enough without any clay, and gives better drainage. If we will set ourselves to work in that line, we can have all the roads we want. I do not think we need to bother our heads over the question of MacAdam roads, etc. We have the material—only take the system, and have the authority to engineer and construct it according to well-known principles, and we will have the results.

The bottom fact of all this, is drainage. Now, what have we got there on that road that is such a success? Why, we have absolutely perfect drainage, and a perfect road bed all times of year.

Mr. Appleton: When this city, some fourteen years ago, purchased what is now called the New Cemetery; they bought it because it was a loose sand, but it was so loose, that in funeral processions, a hack with four persons in it would be stalled in the sand. It was a problem for the council to know what to do to make the roads. One member was very strenuous in advocating a plank road—it was impossible to make it anything else. I urged very much that they allow me to make an experiment on a part of the hill where the most trouble had been experienced. They finally gave me a $120 to work on about sixty rods, and with that $120 appropriation, I went up there, and of course, it was cut down to the hubs of the wheels. You couldn't go through with a buggy; of course, the drainage

was perfect. I put about three inches of clay which I procured right there, and upon that I put gravel—just as it came out of the bank close by. I put on about four inches, and insisted upon every empty wagon, when it drew the clay, going back over the bed, and there was just clay enough. After that course of gravel, I put another course of clay, and then upon that clay I put another course of smaller gravel, from which I was particular to cull the large stones, and we put that on with a rake. I put that over that hill, and I took four or five laborers, and made some road tampers, and the wagons went over it, and it was raked over again, and it has never broken through, and there has never been a shovel put to it so far as I know. Its excellence convinced the council, and they started me all over the cemetery, and I followed the same plan—it is all sand—only of course, I didn't take so much pains, only on this particular hill.

Now, in connection with road making. What is good on one forty rods of road, isn't on another. The character of the soil regulates what you can do. If there had been clay bottom, in this instance, it would have required sub-drainage. Now, that cemetery road, you might imagine, takes no travel; it doesn't take the travel that Michigan Avenue does here, but it takes a great deal—a vast amount of light travel—hacks, hearses, visitors, and every once in a while, a twenty-ton monument; and I have seen a twenty-ton monument going up there and the horses were not phased; that bears out Mr. Steele's idea,—use the material at hand.

MR. STEELE: How much did you put on the third coat?

MR. APPLETON: I was right there. There is a sort of gravel that is mixed up with loam—there is very little of it. I didn't use that for the lower courses. There was not more than four inches thick of it—that, I kept to go over the last time, wherever there was a little bit of a depression.

MR. VINCENT: How wide did you make you road?

MR. APPLETON: I can't tell you just how wide it was—I made it just wide enough for two teams to pass, and it has stood, I think, about fourteen years.

MR. VINCENT: How much did you crown it?

MR. APPLETON; Not enough to make it unsightly. It

wanted to be a little nicer than a country road—not more than three inches on twenty-four feet.

MR. VINCENT: Did you make the clay foundation crown also?

MR. APPLETON: No, sir, it has perfect natural drainage. The sole purpose in putting the clay on the bottom, was to keep the sand from coming through.

The first course was about four inches clay, then three inches gravel, and then a top dressing of this finer gravel. I had no roller, but I had some broad wheeled wagons, and as the empty wagons went along, I insisted on the broad tire going over different parts; finished off with a garden rake.

MR. VINCENT: I am very glad to hear this question of clay and gravel discussed. I have seen intelligent men, surveyors, who thought they understood these things, who thought certain kinds of gravel would combine, because they had cement, but another wouldn't, because it did not have that magic property. There is some gravel that will combine, just as it comes out of the bank, but it is the clay that makes it combine. If we are to succeed with gravel, we must have a binding material. If it is not there naturally, we must put it in, as the last speaker suggested. The more intimately the clay is mixed with the gravel, the better.

MR. APPLETON: The clay makes a good dry weather road, but there is nothing worse for winter, and of course, if you mix the clay and gravel skillfully, you get a good road for both summer and winter, and then in spring, when everything is thawed and breaking up, this road never goes down, only just a little, an inch or so, but it immediately dries up.

MR. BAILEY: The question has been asked, why did I want to plow up the middle of the road? This is a question that all road commissioners have stumbled over. You can't make a good road without plowing it up, except such sand as is found up along our western coast. The reason is this: You have all dug holes in the ground, and you never filled up a hole with the dirt you took out; the ground is like a sponge, and if you don't dig it up, it will settle, and the finer you get it, the better it will settle. You may put in all the drainage you want to, you have got a sponge there, and you can't get rid of it.

If you thoroughly plow up that road bed, it will settle down so hard, and roll down so hard, that when you drive a wagon over it, loaded with 3,000 pounds, there won't be a rut over ¼ of an inch. Then you are ready to put on the gravel.

I built a road of this kind twenty-two years ago, and there hasn't been but one days work laid out on that course in twenty-two years. I keep the top soil on top—on sand I would use gravel, picking out every stone as big as a hen's egg. Screen the gravel if possible—and I want, if possible, to have six inches of good gravel.

THE PRESIDENT: The committee for investigating this matter of road laws and memorials: On this committee Messrs. F. Hodgman, H. F. Bean, Wm. Appleton, M. H. Bailey, and G. E. Steele, are appointed.

There is one more paper on the subject of roads, from Mr. Hodgman. Perhaps we had better listen to that to-night, and that will finish up the subject, with the exception of a paper on highway bridges, and that will probably go over until to-morrow.

MR. HODGMAN: This paper was written originally for another purpose—not for engineers in particular, and it will touch on a good many points that have already been pretty thoroughly covered, and some that have not; and I was in hopes that if I presented it here, it might spur some one on to bring out something that has not been already said. So I beg your indulgence, if you hear something that has been heard before.

COUNTRY ROADS AND ROAD MAKING.

F. HODGMAN.

We shall not have good roads until farmers realize how expensive bad roads are. Bad roads cost more than good roads. Many are so used to bad roads that they seem to think such roads are good enough. Some would not have good roads for fear that a dude on a bicycle would use them.

Let us figure on what bad roads cost, keeping well within the truth and putting it in round numbers. We cannot be exact. You can't haul more than two-thirds as big a load, nor travel more than two-thirds as fast on a bad road as you can on a good one. The wear and tear is more. The town I live in has seventy-two miles of roads. They are fairly good for country roads. If they were all as good as the best mile, the average load hauled could easily be half larger than it is. What the difference would be in a year depends on the amount of travel. Nobody knows what that is. Assume that, on an average, six teams per day pass over all the roads in town. That includes everything. In that case the difference would be two teams per day over seventy-two miles of road, because then four teams could do the work that six now do. Call twenty-four miles a day's work. Then six days' work of man and team is wasted each day. Call it 2,000 for the year. At three dollars per day that is $6,000 a year wasted, where the travel equals six teams per day, or $1,000 a year where it equals one team per day over seventy-two miles of roads.

Mr. L. goes seven miles to market. He had 1,000 bushels of wheat to sell, and he wanted the money. He would have sold in March at ninety cents but, as the roads were he could not deliver it. He sold later at eighty-five cents. When he did sell, two loads a day was all he could haul. It made twenty-four loads. He could have just as easily delivered it in sixteen loads over good roads. He lost the expense of eight trips. At $1.50 each that makes $12, which the bad roads taxed him that time.

THE SMALLEST ROAD TAX

we pay is that which is levied in the assessor's roll. The bulk of all this tax is unnecessary. We might as well throw the money into the fire. The highway tax that is assessed to us is enough, if it were all paid in money and properly handled, to make fifty per cent better roads than it does make. We never shall have good country roads until they are made and controlled by men who know how. Road making is a trade. We never shall have road work done economically until it is done under the direction of competent, prudent men and paid for in cash. That involves a change in our road laws. Each township in Michigan has for years had the power to make the change, but how many have done it, or will do it. (See section 1354, Howell's Annotated Statutes.) When the country was new and the farmers in the interior of the state had to haul their wheat to Detroit and sold it there at fifty cents a bushel, money was mighty hard to get. Our road laws were then well adapted to the situation. Things have changed since then. Laws which were good under those circumstances are abominations now. We Americans are a hundred years behind the rest of the enlightened world in the quality and economy of our country roads, and there is small disposition among our farmers to catch up with or to head the procession. Accepting things as they are the best thing to do for the improvement of country roads is educate those who make them.

HOW TO MAKE GOOD ROADS.

Get the best location. That text warrants a long sermon. For main roads between important points use the shortest line which is consistent with the easiest grades, and lightest work in building. Locate the line upon the same principles that a railroad is located. We seldom do it. We locate roads on section or farm lines when it would be cheaper to buy a man's farm outright and get a good location, rather than to locate and build it on the boundary line. We are generous. We climb hills and dig them down year after year, at no end of trouble and expense to the public, just to keep some man's fields square so that his corn rows will come out even. We are going to keep right on doing so.

Having located the line, you want to build a road that shall have a smooth even surface; hard enough so that wheels will not cut ruts in it and soft enough for horses' feet to take a firm hold without slipping when hauling loads. If somewhat elastic it will be pleasanter to use. In some respects asphalt pavement is the ideal road.

Clear the road-bed of trees, brush, stumps and stones, if there are any. Cut down hummocks and fill holes. Subsequent treatment will vary as the soil varies. As soon as things are ripe for it, begin grading. Do it systematically. Adopt a permanent grade and work to it, so that work once done will stay done. Finish as you go. Do not begin grading a foot more road than you can finish while you are at it. This does not apply to the big hills and hollows that must be dug down and filled up to all eternity.

Drain clay soils thoroughly. Water *must* be speedily got rid of if you would have a good road. Read that over till you have it by heart. Do not be afaid to go outside the road. Ask the owner to help you open the watercourse across his land till the water has a free outlet from the road. If necessary call on the drain commissioner. A few dollars spent in this way will sometimes do more good than ten times the amount spent on the road itself. Tile drains are a great help to some roads. Lay them lengthwise of the track on each side of it. They do little good under the track because the surface becomes puddled so the water does not reach them readily. Be sure the tiles are laid to a true grade and have a free outlet. Wherever there is a sag in the tile the sediment will settle. If the sag is as great as the bore of the tile it will sooner or later cause an entire stoppage. Lay the tiles from two to four feet deep, according to circumstances. Clay roads must be turnpiked or raised in the center, to carry off the surface water. Plow a back-furrow down the center of the road and keep plowing in until it has the desired slope. Keep the ground finely harrowed so as to have the soil perfectly homogeneous and uniform. Do not raise it too high in the middle. A rise of one in twenty is enough.

In Chicago they used to raise the center of the streets eighteen inches. They now raise them only eight inches and

get better results. When a wagon is on the slope of a turnpike it is tilted to one side. The most of the weight is on the lower wheels, increasing their tendency to cut a rut, which will intercept and hold more or less of the surface water. That softens the ground and the wheels cut deeper. So it goes on from bad to worse until the limit is reached. The steeper the slope the worse it is, defeating the very object it was made for. The strain on the wagon is greatly increased, and by taking the lower wheels and axles at a disadvantage, greatly increases the danger of breakage.

DO NOT USE

a scoop scraper in finishing a road bed. It is a nuisance. It leaves its loads in hard bunches with soft spaces between, some of which will surely develop into mud holes. Flat scrapers with tongues are much better. You can distribute the dirt evenly with them. A road machine is a good tool to finish the surface with, if you know how to use it, or to spoil it, if you don't. When you have the road thoroughly worked, and just where it ought to be, roll it down hard. Farm rollers are not heavy enough to do the best work. Rollers are made on purpose for it, and ought to be used more than they are. Bring the road bed to the grade where it is to stay the first time you plow it, and then be sure that the plow is never put into it again. A man who will plow up a graded and well settled road bed, ought to be prosecuted, and fined to the full extent of the damage he does, including damages done to people's feelings who have to travel over such a road.

If the soil is muck, put an open ditch on each side of the road at least twenty feet from the center, and give it free outlet. If you have good reason to suspect the presence of a sink hole, do not cut the surface at all, as it will do more hurt than good, in case there is one. If the muck is very soft you may have to put in a log crossway for a foundation. Put good solid stringers lengthwise of the road bed. Notch the cross-logs onto the stringers so they will stay firmly in place, and be as even on top as possible. If they are flattened on top, so much the better, they will need but little covering. If not flattened, put on a good layer of brush and marsh hay, and cover it with the best dirt you can get. A log crossway becomes in time a

great nuisance, unless the logs are below frost. The frost lifts them, and keeps the road filled with bumping places.

Except in the softest ground, brush makes a better foundation than round logs, and will last until the ground is settled, so it is no longer needed. Use plenty of it. Pack it as closely as possible, and give it a good covering of gravel with a little clay in it if you can get it.

DO NOT TURNPIKE

a sandy road, nor drain it. Wet sand makes a better road than dry sand. I am not speaking of quick sand. Sandy roads are usually pretty level, and need little, if any grading. They should, where it is necessary, be leveled off as evenly as may be. Encourage grass to occupy all the space it can. It pays well to give some sandy roads a heavy coat of manure for the benefit of the grass. Don't turnpike a sandy road. It is a damage to it. Put a coat of six inches or more of stiff clay on a sandy track, and it makes a pretty good road of it, Straw, marsh hay, waste from sorghum mills, and the like, make good temporary applications for sandy roads. They improve the roads greatly while they last, and it pays well to use them in bad places when you cannot do better.

The time soon comes in the life of a road if it is much used, when it will pay to give it a better surface than can be had from sand, muck or clay. Where gravel can be had it is the first thing to use. It makes a surface hard enough for almost any country road, and is a good foundation for a pavement. When you gravel a road, begin at the part nearest the gravel, and put on an even layer about four inches thick, driving over it as the teams come and go. When one such coat is on, wait awhile until it is solidly packed by the passing travel. Then put on more in the same way, until you have enough on. The object in applying it in this way, is to have all the gravel solidly packed from top to bottom. It makes a big difference whether this is done, or whether you have a hard crust on top with loose gravel beneath. If you have a good road roller, you can pack the gravel with that, without waiting for the teams to pack it. The foundation too, should be rolled as hard as possible. Don't use sand instead of gravel. It is a waste of time and money. The gravel should consist of grains

from the size of a kernel of wheat to a hickory nut. Sharp, angular grains are best. If the gravel is to be put on sand, a little stiff, tenacious clay mixed with it, is an improvement. On clay, it will get all the clay it needs from the road bed.

When your road bed is well graveled, let it alone, except to patch up any holes as soon as they show themselves.

DON'T PLOW IT UP.

Nothing better than gravel will be needed for a majority of country roads. When the traffic will warrant paving, it will generally warrant a railroad, which is pretty sure to come. If the road must be paved, call on an expert for advice. It is the best and cheapest way. I will suggest, that brick is now considered to make by great odds, the best pavement that can be had for the money. House brick will not do. They are too soft. Brick are made on purpose and burned very hard and tough. They are nearly as durable as granite, and can be put down for two dollars or less per square yard.

I will close with a very few words on repairing dirt roads. A road machine is the most effective tool I know of for this use. It wants a man to run it who knows his business. Such men are scarcer than the machines are. The machine should be run over the ground in the spring as soon as the ground is well settled, and afterwards during warm weather as often as the roads become rutted. It will smooth down the rough places, fill the ruts, and leave the road in the best possible shape. If not properly used, the road machine is a nuisance. I believe that a great deal more harm than good has been done with them. Too steep slopes are made with them, and big ridges of loose dirt are left in the center, compelling teams to follow the slopes. No ridge of loose dirt should be left. It should be evenly spread over the surface with the machine, and then rolled down hard.

MR. ROGERS: There is one thing that has not been referred to to-day; that is a good road roller drawn by horses or run by steam. If there are any here who have had experience, would like to hear from them.

MR. HODGMAN: I would say that the O. S. Kelly Co. advertise a good road roller in our annual, and if any members have

use for a road roller, I wish they would consult this company. I believe in patronizing the people who patronize us. We hope in our next Annual to give you the advertisements of other firms who make road rollers.

THE PRESIDENT: There is one more paper incidental to this subject relative to highway bridges by Mr. LaRue.

THE PURCHASE OF METAL BRIDGES.

BY BENJ. F. LA RUE.

Where our path is obstructed by an abrupt depression which we cannot travel through, our alternative is to bridge it that we may travel across. Few highways have been made for the purposes of public travel that have not required the construction of some kind of bridges. In recent years the art of bridge building has developed very rapidly, so that to-day we do not hesitate to attempt to bridge whatever obstacle we cannot remove or otherwise overcome. In these attempts we build bridges and we build bridges—some good, some bad, some quite indifferent.

Just at present the subject of good roads is being urged prominently to our notice by the ever increasing requirements of public travel, and we, as engineers, shall scarcely hold our places in the advance guard of human progress if we do not give to this important subject that attention which it is demanding.

Recognizing the positive demand for good roads, the officers of this Society have wisely given that subject a prominent place at this meeting; and as good roads, comprehensively speaking, are impossible without good bridges, the writer was requested to prepare a paper on the ordinary structures of small span, common to nearly all highways, as an auxiliary to the discussion of the general subject. Though of small dimensions individually, these structures are very important because very common, and they are often very poorly designed—if some of them can be said to have been designed at all. For this reason it was desired that the subject should be treated

quite thoroughly and somewhat in detail, but as such treatment of the subject would require considerable labor and the time was rather short, the writer concluded for the present paper to take up a feature of bridge construction which would be treated rather more superficially. The thorough treatment of small structures will make a good paper for a future meeting.

The subject to be now taken up is of no small importance, and it is very pertinent to the general subject. It is the purchase of iron and steel highway bridges.

Of recent years nearly all bridges of importance or of any considerable span are constructed of metal and are purchased from companies who make a specialty of metal bridge construction. A few observations in regard to this purchase may not be untimely; for among those who are informed concerning these transactions it is an open secret that the sales of metal bridges are often conducted upon what could not be designated sound business principles.

The man who offers to sell you a yard of shoddy for a less price than another tradesman offers you a yard of genuine cloth, does not usually offer you a better bargain. The honest tradesman who charges you a somewhat higher price for the reliable article really gives you a much better bargain, though to the inexperienced eye the shoddy may appear as good as the genuine. If you purchase the cloth you make an honest transaction and the tradesman makes a legitimate profit; but if you buy the shoddy you are deceived and cheated. But if the dealer in shoddy charges you a price that is actually higher than is charged by the honest tradesman for the genuine article, representing to you that his shoddy is very superior material, and you are persuaded to purchase those qualities which by strong flights of imagination and the most sublime lying you are led to believe the shoddy possesses, rather than those sterling but ordinary qualities which by the exercise of common sense you know the genuine article to possess, you are duped and swindled. If a dealer simply "sizes you up," ascertains how much money you have and charges you just that much or a few cents less, for the poorest article which by reason of your inexperience he can persuade you to accept, guaranteeing it to be the very best, you must not look upon that dealer as a swin-

dler—rather thank him for the few cents he leaves you. But if all the dealers in some article in your vicinity, learning that you intend to purchase that article, band together, ascertain how much money you have to pay and how poor an article can be imposed upon you, and mark up the price of that article so that the poorest one which you can be persuaded to accept will just take what money you have to pay, or a little more or less for appearances—well, that *is* robbery, indeed. You have not a very high opinion of tradesmen who gauge their prices according to the amount of money they are able to extort from the buyer, wholly regardless of the actual worth, or lack of worth, of the article sold.

But the writer has been digressing; he has been wandering from his subject and writing about dishonesty and swindling when he should have been writing about bridges. He will resume his subject.

When a metal bridge is to be built, one of the first steps in the ordinary method of proceedure is to advertise for proposals for its construction, as is usually required by law. This is, in intent, a good law; it admits of abuses, but on the whole it probably works to the interest of the public, for the abuses could be greater did the law not exist.

Proposals are usually advertised for several weeks, but as a rule none will arrive until the last day upon which they are to be received. On that day will usually be received a number of proposals, according to the importance of the structure and the prominence of the advertisement; and each proposal will be personally delivered by the agent of a bridge company. Proposals for the construction of highway bridges are almost invariably received in this manner. The thoughtful man will notice this fact and be inclined to look upon it as having some significance. In seeking a reason for it he may ask some pertinent questions:

Why do all these agents come personally to deposit their bids? Why do they not send them by mail and save traveling expenses? "The United States mail," he says, "can surely be relied upon to transport these proposals safely and cheaply," and he cannot understand why bridge companies think it always necessary to send an agent to bid on a highway bridge when

they can bid on large railroad bridges by mail. He is unable to discern any good reason why this should be true, but is inclined to think there is a reason which is not apparent. He does not say this, for the thoughtful man is prudent.

Ah, well; the thoughtful man will draw his own conclusions and will probably profit thereby, while others not so thoughtful will continue to pay dearly for their lack of discernment. The thoughtful man insists that the principles which apply in the purchase of merchandise apply also to the purchase of iron and steel bridges, and that judgment and common sense should be used in the latter as well as in the former. And in this he is certainly correct.

But it may be well to here state that more than ordinary judgment and common sense is required in the purchase of metal bridges. Special experience and ability is necessary if the purchase be a really intelligent one. Any man with ordinary intelligence can distinguish shoddy from genuine cloth and can usually have a reasonably good idea of the worth of either, but only experts, trained and experienced in both the theoretical and practical features of the matter can discriminate with any certainty between an unsafe bridge and a good one, or regarding what may be a reasonable price. He who buys shoddy gets cheated, but that is all. But the official who purchases an unsafe bridge not only allows himself to be cheated out of money that is not his, and thus violates his trust, but he actually endangers the lives of those who have trusted him.

Bridge failures are not every day occurrences, which is a fortunate fact. But such "accidents" do occur, and though not always accompanied by a loss of life so as to be noticed by newspapers, yet several such calamities have occurred with the most terrible results. Those at Ashtabula, Ohio, where over eighty persons lost their lives, and at Dixon, Illinois, where sixty people were killed, are still remembered. The former was a railway bridge, the latter a highway bridge. Neither of these were "accidents;" they were frightful disasters for each of which was a definite cause, and for which some person or persons were directly or indirectly responsible. The Tay disaster and the recent Moenchenstein failure might be noticed as prominent calamities, but these were in foreign countries,

where bridges are constructed under a system quite different from that practiced in this country.

It is not necessary to seek instances of these calamities in foreign countries, for the failure of bridges, in one way or another, are estimated to occur at the rate of from thirty to forty per year in the United States.

It is to be noticed, that in each case mentioned, each bridge failed under a load which it was supposed to be perfectly able to carry; and this is almost invariably the case where bridge failures occur, for it is seldom indeed, that a bridge has to carry a greater load than it is believed, or even guaranteed to be able to carry safely.

In one case (Ashtabula), the bridge had actually carried as great, and greater loads, many times a day, for years. From this and similar cases, we are forced to conclude, that the fact, that a bridge that carried a certain load once, or several times, is no proof that it will carry the same load again. And this is a fact well established, and well known to those familiar with the properties of iron and steel, though it is not readily accepted by those not familiar with the action of these metals under stress.

From this statement it will be readily understood, that all so called tests of bridges, by placing loads upon them, in the usual manner, are mere farces, gotten up to deceive purchasers. In order to really and intelligently test a bridge, it is necessary to precisely observe the deflection under load, and compare it with the calculated deflection for the same load, and also note whether the bridge recovers its exact former position when the load is removed. Such tests, based upon the elasticity of the metal, if properly performed, will give a reasonably accurate idea of the proficiency of the structure. It is a well known fact, that any load on a metal structure which strains the material beyond its elastic limit, will, if repeatedly placed upon it, finally cause it to fail; and this load is not necessarily but little more than one-half the load necessary to break it down when placed upon it the first time. The most ordinary bridge should be able to carry its usual load without straining the metal to more than one-half its elastic limit, or about one-

fourth its ultimate strength; if this be the case it can occasionally carry nearly twice this load without injury.

There are to-day, hundreds of highway bridges in the United States, which, were they loaded with a closely packed crowd of people, or with a close column of infantry, marching and keeping step, would fall under the load; and such a fall under such circumstances would be most terrible. There are probably highway bridges in the state of Michigan over which it would be unsafe to pass an ordinary traction engine. And these unsafe bridges are, for the most part, not old, decayed wood bridges, but comparatively new metal bridges.

Some of our iron bridges throughout the country are standing, simply because they have never been loaded anywhere near their guaranteed capacity, which is usually eighty to one hundred pounds per square foot of road way, with a factor of safety of four; i. e., straining the metal to one fourth its ultimate strength. It has been aptly remarked that many of these bridges seem to stand from mere "force of habit and pure cussedness."

Except from the result of one thing alone—the corroding depredations of rust, which may be prevented by thorough painting and a little care—a properly constructed iron or steel bridge should be nearly, if not quite as good after a life of fifty years as the day it was erected. This statement does not correspond well with the fact, that all over the country iron bridges but fifteen or twenty years old are being torn down and replaced by new ones. The statement is never-the-less true. These bridges, however, have not all been bad ones, though many of them have been very inferior, for in some cases the requirements of travel have greatly increased.

But this talk about the "fatigue of metal," when applied to bridges, is nonsensical and delusive,—every word of it. So also is the talk about crystalization. No piece of iron or steel on this earth has ever been known to crystalize, except through the influence of very intense heat. Speaking practically, and with reference to bridges after completion, there is no such thing as crystalization, or the fatigue of metal. These terms have been used where bridges have failed, simply to excuse bad work and evade responsibility.

To put upon any bridge, other than a very old one, sadly in need of renewal, any such warning placard as "All persons are prohibited from driving across this bridge faster than a walk," is a disgrace both to the builders of the bridge and the officials who purchased it. It shows a shameless amount of either ignorance or dishonesty—or both, on the part of the builders and a very liberal lack of common sense on the part of the purchasers.

Every bridge on a public highway should be perfectly safe for any team to cross as fast as may be desired, for the heaviest traction engine to cross, for a drove of cattle to cross on a trot, or a column of soldiers to cross on double quick march; and a bridge that is not safe to carry any and every such load, is not safe for public travel.

In this connection the writer wishes to make another statement. It is, that the average price paid for metal bridges is sufficient for the purchase of bridges that would be in every way first-class, and capable of carrying with perfect safety all loads that are liable to come upon them. To this is added the statement, that the bridges actually purchased are, as a rule, not nearly as reliable as they should be, and often not as strong as represented to be.

And here the question arises, how can officials when purchasing bridges, intelligently discriminate, as to be certain that they are getting safe and reliable structures, and the equivalent of the money which they expend? The men on whom this duty falls are not usually bridge experts, and are not expected to be; and this fact is certainly not to their discredit, for it requires years of special study and experience to thoroughly master the study of bridge construction.

But the difficulty has a remedy. The engineer may be called upon to make the design, or to examine and report on such designs as may be submitted, to inspect the material, details and workmanship, and to advise in all matters appertaining to the structure. With an engineer, if he be expert in bridge construction, there is absolutely no guess work about all this; it is with him simply a matter of mathematics and experience.

And there devolves upon us engineers, to give more

attention to this subject which is certainly of great importance, and which is a branch of engineering to which too little attention is paid. We may not all become experts in bridge designing, and this is not necessary; but we can, and should, so inform ourselves, that we can decide with intelligence and discrimination concerning the design which may be submitted to us, and have reasonably good judgment concerning the fairness of the price. It is not difficult to know about what it is worth per pound to construct a metal bridge, and the price of the lumber used, and then to estimate the weight of the metal and the amount of lumber in the structure. This is the way bridge companies get at it, though there are usually other minor items to be considered.

There is no possible way in which public officials can so judiciously and economically purchase a bridge, and know the exact worth of what they buy, as by employing an expert engineer to advise them regarding all matters appertaining to the structure.

The committee on road legislation presented a report which was discussed, amended and adopted and subsequently presented to the state legislature in the following form:

MEMORIAL.

To the Honorable the Legislature of the State of Michigan:

The Michigan Engineering Society, in convention assembled in the city of Lansing the 19th day of January, A. D. 1893, adopted the following recommendations relative to the highway laws of the state of Michigan, and instructed their secretary to transmit the same to your honorable body, which is hereby done, with the respectful request that the points presented be given due consideration and such weight given them as their merits entitle them to, in any changes that may be made in the highway laws of the state. All of which is most respectfully submitted. F. HODGMAN,

Secretary of the Michigan Engineering Society.

RECOMMENDATIONS.

1st. We favor the adoption of the amendment to the constitution submitted by the state highway commission, but striking out therefrom all reference to state roads, and we earnestly request your honorable body to present to the people of the

state this or such other amendments to the constitution as may be necessary to give the legislature power to enact effective legislation for the improvement of the common roads of the state. We do not believe there is now or likely to be in the future any necessity for state roads. We would also have the amendment state explicitly that the state aid to be given to counties is for highway purposes.

In the event of the failure of this amendment to carry, we would favor,

1st. Classifying all highways outside of incorporated cities and villages as township roads and county roads.

2d. All township roads to be under the supervision of the township highway commissioner under restrictions to be provided by law.

3d. All township highway expenses to be paid from a uniform township highway fund to be provided by act of the legislature by a levy of not less than $1 or more than $3 for each $1,000 of the assessed valuation of the township. Any amount in excess of that to be submitted to a vote of the electors of the township on recommendation of the highway commissioner, stating specifically the object for which the levy is asked, and giving an estimate of the cost of the proposed improvement.

4th. All expenses for county road to be paid from a county fund to be provided by a similar tax levied upon the property of the county and under similar restrictions.

5th. Extend the powers now exercised by township highway commissioners in acting together, so that all such commissioners in the county may act jointly to determine what roads and bridges in the county are of sufficient importance to the people of the whole county, that they should be constructed and maintained at county expense, and establish the same as county roads and bridges. Provide for a suitable representation of the cities and villages in such cases. Place county roads in their charge, their determinations to be carried into effect by a committee to be elected from their own number. They should assign to each township its portion of roads lying on township lines, and by joint action of committees make partitions of roads lying on county lines.

6th. We would make the township the unit of the road district, and make the township commissioner the overseer. Authorize him to let all road work by contract or to do it by days' work in certain cases where he cannot secure suitable proposals for the work. Provide for constant supervision of the roads and for a check upon the actions of the commissioner.

7th. Require from the commissioner annual itemized reports of all work done and money expended by him during the year, to be made in duplicate to the township and county. Provide blanks for the purpose.

8th. Provide for the purchase or condemnation of the right-of-way for highways, and for the acquiring gravel pits, clay banks and stone and for access thereto.

9th. Require that a plat and a correct description of *all* highways be filed or recorded in the office of register of deeds and in the state land office. Require that permanent monuments be planted at every section corner and quarter post in the United States survey within the limits of the road, at every angle in the road, and at every point where the road crosses a section line, and that the distance be shown to the nearest government corners on each side of such crossing if such corners can be found within half a mile. All this to be shown on the plat. Provide that no money shall be expended from the highway fund upon any highway until such plat is filed. Fix fees for recording highway plats.

10th. Make road laws apply to all platted streets lying outside of incorporated cities and villages.

11th. Fix penalty for moving or destroying monuments planted to define road lines, and provide manner of enforcing it.

12th. Provide that all county roads shall have permanent grades adopted and recorded in some county office with profiles of the same. All heights to be referred to one common base or datum for the county. Where the road lies in more than one county, show the difference, if any, in the datums. Show heights of all railroad crossings and streams, with stage of water when the height was taken.

13th. Provide that all work done in constructing graveled and paved roads be in accordance with detailed specifications, all estimates for earth-work, graveling and masonry to be in cubic yards. If work is done under contract, provide for retaining a percentage of the contract price until the entire work is completed, according to contract. Provide means for a strict enforcement of this rule. Provide that no more work be commenced on roads than can be completed at the time or during the season.

14th. Provide for reports to the county of all work done on county and township roads, of the amount of money expended and from whence derived.

Provide for consolidated reports from every county to the secretary of state, showing amount of mill tax raised, amount

of special tax raised, amount of money expended on roads and bridges, both for supervision and construction, and the length of roads located, paved, graveled, repaired or discontinued.

15th. Provide means of securing right-of-way for drains across private property for road purposes and provide for opening and constructing the same.

16th. Add to the pamphlet of highways laws and blank forms such as are now furnished to highway commissioners, instructions as to the best methods of constructing earth and gravel roads, with plans and specifications of small wooden bridges and of culverts.

17th. Authorize the employment of county prisoners, vagrants and tramps upon work for the benefit of the highways.

18th. It is the sense of this society that from our experience the state as a whole furnishes ample material, of good quality, for the construction of good roads, when applied by men who are qualified to superintend such work and by officers who are chosen with this in view. We believe that we should make the most of what we have—both as to materials and officials. All of which is respectfully submitted by order of the Michigan Engineering Society.

It may be added to the above that it is believed, that even though no amendment to the constitution be made, that the condition of our highways may be greatly improved by an incorporation in statutes of such of the foregoing principles as are not repugnant to our present constitution.

F. HODGMAN,
Secretary Michigan Engineering Society.

Climax, Mich.

At the time of going to press, the secretary is glad to be able to announce that the legislature modified the amendment to the constitution that was submitted by the highway commission, by striking out the part relating to state roads, and making the adoption of the county system optional with the several counties.

The amendment was submitted to the people of the state at the spring election, and carried by a large majority. It is a significant fact that it was carried by the city vote, the majority in its favor in the four leading cities being greater than the majority in the entire state. The rural communities, as usual, voted almost solidly against it.

MR. WILLIAMS: I would state before commencing, that I found when I commenced to do village work, that there were very inadequate means for a beginner to find any monuments or surveys that he could tie to, and to meet that difficulty, I devised something of a system which I have followed. Whether it was good or not, I don't know, and the object of this paper is to bring forth ideas from the members upon some better system than the one I propose.

VILLAGE SURVEYS AND THEIR RECORDS.

F. H. WILLIAMS.

It is an axiom in social and business circles, that lawyers and doctors never agree, and it has been more than delicately hinted that surveyors could well be included in the same category. Be the slur just or unjust, it is certain that surveyors often disagree with the surveys of their predecessors, and that numerous law-suits are the results of such disagreements.

It is a well known fact, that if the person who made the original survey had made a complete record of the same these differences would not arise. Surveyors, as a rule, are more careless in their records than in any other department of their work. Articles without number have been written upon the necessity of records, but that necessity still exists, and will undoubtedly continue. Nine-tenths of the law-suits arising from disputed lines and boundaries would never have been brought, if the records of the original surveys had been properly kept. If such a record is made, so that one surveyor can follow his predecessor, or else the errors be so plain that anyone may detect them, the re-tracing of old lines would be comparatively simple, and litigation would be less. The young surveyor very naturally follows the old surveyor, and while he condemns the methods and work of his predecessor, yet he leaves his work with no other monument to his memory than a series of rotten stakes.

In the surveys and grades of villages, this necessity appears as prominently, if not more so, than in any other

department of a surveyor's work. There is, of course, that foundation of all the records, the village plat. I used to regard that village plat with a great amount of veneration and awe, but active contact with it has destroyed all my veneration. While indispensable as that bit of drafting paper is, it is very similar to a city directory twenty years old. Nothing is located where it purports to be. The stake that was at the north-east corner of lot one, block one, has taken a permanent residence at the south-east corner of some other lot. The monuments and stakes, if there were any, are there no more. An indefinite line with no marked length frequently designates the size of important lots. The difficulties which arise from the village plat, are too well known to every surveyor to need any comment. The location of monuments by the memory of the oldest inhabitant, or last year's wagon track, is, to say the least, a very undesirable, if not exasperating, method.

The question which it is the object of this paper to discuss, is some simple, practical manner by which the records of the grades and surveys of a village may be so kept that the surveyor can ascertain the details of the work of the former surveys, and can follow them when right, and avoid the errors when wrong; that the monuments may be so located that anyone can find them, and that the records when made can be used as evidence in any court of law, where there is litigation on these subjects.

In the first place, the charter of every village and the general law should require that each village should appoint a village surveyor, who shall be required under the authority of the common council to establish grades for all streets, and place monuments at the intersection of all streets; shall be required to keep records of all grades and surveys made by him. No other person should be allowed to work in the village without taking out a license, and agreeing that he will furnish the village surveyor with a record and plat of all work done by him. These records and surveys should be recorded by the village surveyor, who should receive a fee from the village for making the record. All such records should be made prima facia evidence of their correctness, in all cases of controversy in the courts. A very convenient method of keeping these records can be made in the following manner:

First, there should be profiles of each street, showing of course, the rise and fall of ground in the center of the street, and also the grade line. Underneath this profile there should be a plan of the street, on which any alteration of the grade for the sidewalk and gutter can be easily minuted. These profiles are intended principally for working plans, and can be easily preserved by pasting in a large scrap book. A book twenty-four by forty-eight inches can be obtained for ten or twelve dollars.

All the grades of the village should be referred to one datum established by the village authorities, and the grades be established by reference to the heights of the grade at the points where changes are made.

Second, for a record of these grades a book can be made containing at the head of each page reference blanks to the proceedings of the common council where the matter was considered, a reference to the surveyor's record book, and also to the profile book. These pages are lined, and marked into columns. The first column shows the stations, the next column shows the height of the grade at each station where the grades angle, and the third column shows the location of the angels in the grade by streets, or other references.

Third, the more complete record however, can be conveniently kept in a third book, known as "The Surveyor's Record Book." This book is headed in much the same manner as the Grade Record. It has reference blanks to the proceedings of the common council, reference to the profile book, and also the grade record. The left hand page of this book is lined, and is specially adapted to the record of grades. There are three columns, one for the number of the station, one for the height of the ground, and one for the height of the grade. There should be written in this book the height of every station, and also, if deemed necessary, the side heights. The balance of this page is left for the location of monuments, which may be given with witnesses, whereby each stake may be replaced if lost.

The right hand page of this book is left for records of surveys made, which adjoin upon the street named on the left

hand page. By means of this book, after the street is once surveyed, and the record of the work made, any surveyor can follow his predecessor, can make estimates of dirt to be moved or the cost of improvements, can find any monument in a short time, and a complete record of the history of each street, and the improvement made upon it can be preserved. If this book is kept up, both of the others could be done away with, although it is much more convenient to use the whole set.

It may be said with some force, that there is a great amount of labor in keeping such records. It is true, but I do not think it is any more labor than it would be to hunt in the streets for monuments which ought to be there and are not, for grades located by sidewalks which have long ago been torn up, or for lines of surveys which have no more record than a rotten stake or bent gas pipe.

In other words, if the work is well done once, and the record of that work carefully preserved, there is much more value given to the village than there could be through a dozen of surveys of which no trace can be found.

MR. GRANVILLE: Do I understand the gentleman to say that he advocated the system that a village should license a civil engineer or surveyor before he was permitted to practice in that village?

MR. WILLIAMS: No, my idea was that any person practicing, should place the results of his work so that anyone might have the benefit of it.

MR. GRANVILLE: Then the idea is that each surveyor who might go into a village to do a little private work, should gratuitously give the result of his labors to anyone who may come in. It seems to me that a surveyor's private notes are his stock in trade, and that it isn't doing him justice to compel him to give them away without any consideration. It is all right where the work done is public work, and public record should be made; but it seems to me where a surveyor does private work, his notes belong to him alone.

THE PRESIDENT: Did I understand Mr. Williams to say that any man who does any work, should follow this plan?

MR. WILLIAMS: No, only to the extent that when his work is

completed, it should be so placed that anyone can find it. I don't think this would apply to a city.

MR. GRANVILLE: It seems to me that it is the duty of city or village authorities to have their streets properly monumented, if it has not been done before they reach that point of development. They ought to do it, if it was not done in the original platting; and if it becomes necessary for a private surveyor to go on and make his surveys, and if he establishes permanent monuments, it is done at the cost of the parties for whom he is doing the work. It might be a good thing for the public to know these facts; but some one ought to pay the surveyor if he is going to open up his private notes.

MR. WILLIAMS: If there is anything which the public ought to know, it ought to be where the public can know it.

MR. GRANVILLE: And the public ought to pay for it.

SWING OF THE COMPASS CARD, EMBARRASSMENT OF SHIPMASTERS, AND FINDING THE MAGNETIC POLE.

H. C. PEARSONS.

There is a swing of the mariner's compass card in azimuth, always deviating vessels to the north of their supposed course, particularly on the great lakes and the Gulf of St. Lawrence and other places where the isogonic curves are close together, that is a perpetual menace to the safety of the vessels traversing those waters, and a mystery to our seamen.

This swing, or motion of the card in azimuth, is not generally known, and consequently is never recognized in shaping the course of vessels, though it is readily shown and the resulting consequences explained when we come to know the place of the magnetic pole.

So far, this point has never been definitely located. Capt. Jas. Ross has indeed found a point in lat. about 70° N., long. 96° W., where the magnetized needle stands vertical; and for a time this was supposed to be the magnetic pole. But later observations showed an immense field to the south and east of this point, over which the intensity of terrestrial magnetism is very much greater than at the vertical pole of Capt. Ross.

Some point, of necessity, in this field, must control the direction of the magnetic meridians in the northern hemisphere. When this point becomes known, all the motions of the card due to terrestrial magnetism, may be explained.

Having been diverted twice during the last season (1892) from my objective point, over the same route on Lake Superior, in vessels whose compasses I had just compensated and swung for quadrantal error, so that we knew the position of the card for all headings of ship, I thought it time to know something of the cause of such results.

I first conceived the idea of constructing a Mercator chart, embracing some 20° of latitude and some 40° of longitude, such

chart to cover the region of the lakes and the Gulf of St. Lawrence. Then from different points on this chart to project the variation recorded from observation for those points, and to observe their common point of intersection, which I deemed would be the magnetic pole.

But I soon found my mistake as to the kind of projection wanted.

The variations for the different geographical positions are referred to the geographical meridians, which converge to the pole, while the meridians of Mercator's projection are parallel, affording no such convergences to a common point.

I then made a conic projection, tangent to the 44th parallel, and finally one to the 47th parallel of latitude, so as to embrace in each the territory above specified.

Then I projected the variation as recorded for different geographical positions by means of lines representing magnetic meridians, expecting these meridians or variation lines to meet at some common point in the magnetic field above mentioned. But, to my surprise, no two pairs of these lines that were neighbor to each other, would meet in the same point. Thus, two neighboring lines projected from points to the south-east of this field, would intersect in a point far to the north-west, while the two lines projected from the south-west would intersect far to the north-east of this field—say a thousand miles or more from the first intersection, and so of all the lines projected—any two neighboring lines projected from one side of this field would intersect in a point far on the other side. Yet I observed that they all crossed each other within a small area, a circle embracing, say, 3° of latitude, and their crossings were very evenly distributed over this area, the center of which I deemed to be the "*magnetic pole*," that governed the direction of the magnetic meridian in the northern hemisphere.

This center I found from both projections to be in latitude 67½° N., longitude 86° W.

And here I may remark that these variation lines or magnetic meridians all appeared to be governed in their intersection by a law analogous to that regulating the plumb line which points, not to the geometrical center of the earth, but

the center of the nearest mass. And we may further suggest that if we assume this magnetic field above referred to, to have a form enlongated in the direction of south-east from the geographic pole, we find the explanation of why the "agonic" line has a "porthand" course, i e., a course that is to the left of the geographic meridian.

Though the graphic method of solving such problems cannot claim to great precision, the fact that both projections give the same results, and the further fact that computations for the motion of the card, based on a knowledge of the relative polar distances, agree almost precisely, as we shall see, with those deduced from observation, for the different geographical positions, show us that for all practical purposes *this determination for the place of the magnetic pole is correct*, though a more elaborate discussion may change it slightly.

Now, comparing the tangents of the two polar distances from any parallel, we have the inverse ratio of the motion of the magnetic needle or the magnetic card to that due to the inclination of the meridians for any difference of longitude. Thus, with this ratio, the inclination or convergency of any two meridians on any parallel of latitude, becomes the measure of the motion of the card between those meridians, subject to limitations to be mentioned.

From consideration of geometry, we know that the inclination of any two meridians on any parallel is found by multiplying the sine of latitude by the difference of longitude intercepted by the two meridians.

To find this ratio, an example will illustrate:

Say it is desired to find this ratio for the polar distance for lat. 43°.

The geographic polar distance $= 90° - 43° = 47°$.

The magnetic polar distance $= 67\frac{1}{2}° - 43° = 24\frac{1}{2}°$.

Thus,

$$\text{Tan. } 47° \div \text{Tan. } 24\frac{1}{4}° = 2{\cdot}35.$$

That is to say,

The motion of the card for any difference of longitude on that latitude, is 2·35 times the inclination of the meridians embracing such difference of longitude. In the same manner, ex-

cept with the use of logarithms, the following ratios are found:

Lat. =	48°	47°	46°	45°	44°	43°	42°	41°	40°
Ratio =	2·54	2·49	2·45	2·41	2·38	2·35	2·33	2·31	2·29

Thus, multiplying any difference of longitude by the factor or ratio for any latitude, and by the sine of such latitude we have the total swing of the card in azimuth, for that latitude and difference of longitude. Or, rejecting unity from the factor, the product will be the change of variation.

A few examples will illustrate:

From Buffalo to Duluth the difference in longitude is 13°, 12′ (See U. S. List of Lights), and the mean latitude is 45°, the sine of which is ·707. Then the total swing of the card is

$$13°{\cdot}2 \times {\cdot}707 \times 2{\cdot}41 = 22°{\cdot}44 \text{ of azimuth,}$$

and the change of variation is

$$13{\cdot}2 \times {\cdot}707 \times 1{\cdot}41 = 13° \cdot 16.$$

From the variation chart of Johnson's Surveying, we have variation by observation

$$\left.\begin{array}{l}\text{at Buffalo} = 4°, 9 \text{ to left} \\ \text{at Duluth} = 8, 7 \text{ to right}\end{array}\right\} 13°, 60.$$

Now as the change of variation is but the excess of the motion of the card over the inclinations of the meridians, if we diminish the total swing by the change of variation, we will have 22° ·44—13° ·16 = 9° ·28 = the inclination of the meridians passing through Buffalo and Duluth.

This 9° ·28 is the part of the motion of the card that is diverting vessels on the lakes to the north of their supposed course. And until within some two or three years, no correction was applied for any part of the swing. Now, however, the change of variation is corrected by taking the "mean" variation of the route over which it is desired to sail, into consideration when shaping course, leaving, as before said, that part of the motion of the card due to the difference of longitude, to divert the vessel to the north. For, if we go down the lakes the card turns to the left, diverting the ship to the north; and if we go up the lakes the card swings to the right, diverting the ship to north as before.

Thus before the "mean" variation was applied in shaping

course, the one-half of this total swing of 22° ·44, or say one whole point was effective in diverting vessels to the north between Buffalo and Duluth.

The departure, or distance due east or west made by a vessel traversing the route between these two ports, is 647 statute miles, as measured on the parallel of 45°, which is about their mean latitude. And the departure, to a one point course for that distance is 126 miles.

Then, because the ship sails on a curve instead of a right line, the northing due to the swing of the card will vary as the square of the distance of eastings or westings made.

Thus if the ship make eastings or westings, say sixty miles, she will make northings one and eight hundredth miles, due entirely to the swing of the card. And if she make another sixty miles of eastings or westings on any course without correcting course for change of variation, she will have made four miles of northings from the same cause.

And this increase of the northings, according to the square of the distance sailed, will continue so long as the ship continues to sail without adjustment of course of change for variation—no matter how many, or what course she may sail on.

This is the bear that has worried our shipmasters on the lakes since vessels have been known there. And this same bear is worrying them now on the northern part of our Atlantic coast, and on the Gulf of St. Lawrence, and has been doing so ever since our history began.

As an illustration of the disasters resulting from a want of a knowledge of this motion of the mariner's card, we may refer to the two hundred wrecks, more or less, on *Sable Island* alone.

This island is some thirty-five miles long east and west, by about three miles in width, with a wide area of sand reefs around it, and located in N. Lat. 44° and between Long. 60° and 61° W.

Being in close proximity to the highway of vessels between Cape Race and our Atlantic ports, it has become a source of terror and dismay to shipmasters—particularly of strangers who have to go into the vicinity of it. So fatal has it been to vessels, that it has become known the world over as "*The Ocean Burying Ground.*"

The consideration of a case will show how this motion of a card, which has hitherto been unknown or unheeded, has contributed to the disasters above mentioned. *Example:*

Suppose a ship—a stranger—from the North Atlantic, when off Cape Race, wishes to shape course for New York or Philadelphia.

Knowing the island to be near his course, the master lays his route some thirty to forty miles to the south of the island, lest he may not have bright weather to afford an opportunity for finding latitude, when wanted—and thinking too, that so much of an offing would cover any possible error in shaping course.

The difference of longitude between Sable Island and Cape Race is 7°—near latitude 45°, and distance say, four hundred miles.

Then calling the sine of latitude .7 we have $7^{s} \times .7 \times 2.4 = 11°.76 =$ the total swing of the card between those places. And as it is usual at sea to apply only to the variation at ship in shaping course, then half of this swing will be effective in diverting ship to north of the course she may set out on, for we know that the angle between a tangent and a chord, is measured by half the arc intercepted by the chord.

Then going to the traverse table with the half of this angle, or say 5° 50′ as a course, and with four hundred miles as distance, we find 40.06 miles as a departure. Then multiplying the sine of the course, which is say, S. 60° W., we have 35.21 miles as the northing due to the swinging of the card. So the chances are, that our shipmaster would lay our ship away somewhere on the north side of this dreaded "Bone Yard" of the sea.

This same result may be found in another manner. We have seen that for every sixty miles of departure on Lat. 45°, or near that parallel, the northing due to the swing of the card is 1.08 miles, and that it varies as the square of the distance, and that the difference of Long. is 7°, and from nautical tables we find one degree of Longitude on parallell 45°, is forty-nine miles—that is, our westings are

$$7 \times 49 = 343 \text{ miles, and}$$

$$60^{2} : 1.08 :: 343^{2} : 35.27 \text{ miles northing,}$$

due to swing of card—almost precisely the same result. And we may remark the close agreement of our computed motion of the card, with that given in "*Bowditch's Navigation.*" (latest revised edition.)

The total swing 10°.76, diminished by the inclination of the meridians, is the change, thus

11°.76— 4°.90= 6°.80=change of variation.

Change per. observation= 5°.88, as per. Bowditch.

Here we should remark, that we are too far east for the law of the ratios 2.4 to prevail, as we shall presently explain—though as our course lies almost precisely across the isogonic curves, our results by computation may be regarded as quite correct.

And it must be observed too, that the isogonic curves are supposed to cross the parallels at right angles, and this, for all practical purposes may be regarded as so on the lakes, but the case is very different along the northern part of our Atlantic coast, and on the Gulf of St. Lawrence, where they cross the parallel at an angle of about 52°, so that a given amount of longitude does not cross as many of them, as if they crossed the parallels at right angles.

Then multiplying the expression used for the lakes, by the secant of this angle, we will have the change of variation that would be traversed by a given amount of longitude at right angles to them. An example will illustrate.

Say it is desired to compute the change of variation between 75° and 65° of W. Long., for mean Lat. 43° N.—embracing the coast from Delaware to Halifax.

Arranging for logarithmic computation, we have,

Diff. Longitude =	10.	Log.	= 1.0000
Mean Lat. 43° : Sin. =	.682	"	= 1.8338
Ratio Less 1 = 2.35 — 1	1.35	"	= .1303
Secant 52° =	1.624	"	= .2106
Change of variation =	14.°96	"	= 1.1747

From table 50—Bowditch, we find for

Lat. 45° N. Long. 65° W.	Var. =	21°. W.
" 40° N. " 75° W.	" =	6°. W.
Change for variation pr. observation	=	15°

This close agreement of the computed with the observed value of the change of variation, for change of geographical position does not prevail to a great extent from the plane of meridian 86° W., but it speaks, not only for the excellence of the work of observing for variation, but for the correctness of our determination for the place of the "*Magnetic Pole.*"

By going east or west from the plane of this meridian, to a meridian that is at right angles to this plane, or nearly so, we come to a point from which the distance to each of the two poles is the same—or nearly so, for some distance.

At this point, all the ratios that we gave in a table, become unity, and pass to the reciprocal form—attaining their minimum value at the opposite longitude—same latitude. Thus, the ratio of 2.4 for latitude 45, becomes unity at a quadrant distance from us east or west, and $\frac{10}{24} = \frac{5}{12}$ in the opposite longitude.

The place at which they become unity, is indicated on the variation chart by the isogonic curves, becoming tangent to the parallels of latitude, or nearly so—so that change of longitude produces little or no change of variation.

These areas of little or no change of variation, for change of longitude are seen at between 30° to 50° W., and between 110° to 150° W. longitude—Latitude 30 N. to northward, where only changes of latitude gives much change of variation.

At our opposite in longitude, the distance to the magnetic pole being greater than with us, the change of variation will result from a deficit of motion of the card, and a vessel would be diverted to the south, instead of the north, as with us.

Having learned how to compute the swinging of the card in advance, for change in geographical position—particularly on the lakes, our Atlantic coast and the Gulf of St. Lawrence—where of all places on the face of the earth shipmasters are in want of help—we are prepared to show, at least, a "*little light.*"

It will be observed that the factors we have used in our computation for the swinging of the card between say, latitude 40° and 50°, vary so little, that for all practical purposes, we may take the mean of each of them for the factor for the whole belt of latitude.

Thus, we may take for the mean ratio,	2.38
which diminished by unity for change of variation, is	1.38
For sine of the mean latitude, take	.69
For secant of obliquity of isogonic curves, 52°	1.62
For the divisor 2. take	.5

Then collecting these factors into one, and representing the difference of longitude to be traversed in the contemplated run of ship, by D, we have

$$1.38 \times .69 \times 1.62 \times .5 \text{ D} = .78 \text{ D} = \textit{Correction.}$$

RULE.

That is to say, .78, or for convenience of computation, say 80% of the difference of longitude to be traversed, is a *correction* to be applied to the right, in making eastings, or to the left in making westings, to counteract the swinging of the card.

Applying this rule for the correction of our run from Cape Race to Sable Island—difference of longitude 7°—ship making westings, our correction should be to *left* $.8 \times 7° = 5°.60$

Our correction by full calculation was = 5°.88

On the lakes where the practice of taking the mean variation over the run to be made is in use in shaping course, I have recommended to

Take half the longitude to be traversed as a "*correction*" to be applied, as in the above rule.

I have had the pleasure of seeing the vessels that run me off my course in the early summer, make a first-class course over the longest single run on Lake Superior,—having instructed the masters in the above rule.

Ferrysburg, Mich., Jan. 13, 1893.

Drainage Survey: "Waiting for the Line to be Cleared."

A CASE OF DRAINING THROUGH QUICKSAND.

F. F. ROGERS.

The Crapo farm is intersected by the C. & G. T. railway at a point about twelve miles west of Flint, in T. 6, N. R. 5 E. It was formerly bought by ex-Governor Crapo, is now owned by W. W. Crapo and managed by S. T. Crapo, grandson of the ex-governor.

The farm consists of something over 1,000 acres of land, a large part of which originally was a bad marsh depending on Swartz creek for an outlet. The main drainage is secured by a large open ditch extending from Swartz creek westerly through the center of the farm. This ditch, when my attention was first called to it in the summer of 1890, was not deep enough to give satisfactory drainage to the upper parts of the marsh. I ran a careful line of levels along the ditch, taking reading in the bottom of the ditch and on the bank, finding very little fall—about one foot to the mile. I established a grade line from the bed of Swartz creek with a fall of .04 of a foot to 100 feet. This caused a cleaning out and deepening of the old ditch from six inches to one and one-half feet. This was done, but in so doing a stratum of quicksand was encountered, about one foot above the grade line, near the center of the farm, and where the ditch was from four to six feet deep. However, the work was carried on to completion, and the next year I was asked to examine the ditch again and see how much the bottom varied from the established grade. I found it all right except through this quicksand where it had filled, as a matter of course, one foot or more. Then we decided to put in an eight-inch sewer pipe with well cemented joints through this quicksand and on the established grade, the ends opening in silt basins made of plank.

This sewer pipe was laid one side of the center, leaving the open drain obstructed as little as possible. All of the tile on this part of the ditch were admitted to the sewer with the proper connections.

This has been in successful operation over a year; has not varied at all from the grade line as established, carries all of the flow in dry weather, while the open ditch serves for an overflow in times of high water. Thus the lands above the quicksand were provided with as good drainage at though the quicksand had not existed.

THE PRESIDENT: This paper reminds me of an incident in my early experience, and shows how easy it is sometimes to accomplish what seems to be a very difficult operation. It was the first sewer which I had ever constructed, and I had very little experience in anything but railroad engineering.

I employed two courses of brick and a wooden skew back. These skew backs were eight feet long. The contractor came one day and said he would have to throw up the job; he had gotten into a bed of quicksand and had tried every possible expedient to get through, but with no success. As fast as he would put the brick in they would disappear. I went down to see what the trouble was. I never had had anything to do with any such thing before, but I knew that it wouldn't answer to let him or anyone else know that I didn't know what to do. It happened he had been using some slabs from the saw mill, eight or ten feet long, for holding up the sides of his ditch, and as a last resort, I told him to lay these slabs crosswise, across the ditch, and then go on. He did so, and although that was twenty-one years ago it has not given the slightest trouble since. All that was necessary was to keep the brick out of the quicksand until the mortar had time to set.

MR. SKEELS: I was employed this last summer, in laying the track for the Lansing Driving Club, near this place, on the west side of the grounds. We had to do a good deal of grading, and just as the work was nearly completed, we struck a bed of quicksand—places as large as the table where it was all of a teeter; and they thought they would have to raise the grade of the whole track in order to get rid of it. I suggested to them to lay a tiled drain from that quicksand to a point where they had tiled drain already. This was Saturday. They commenced then, and put tile drain in, and had it in operation early Sunday morning. Monday noon we made an examination of the ground, and it was solid enough so that we went on with the construction of the track.

PUBLIC WATER SUPPLY AND PUBLIC HEALTH.

W. R. COATS, C. AND S. E.

Mr. President and Gentlemen of the Convention:

There is perhaps no question before the American people today, and it involves all the peoples of the entire human race, of such transcendent interest and importance as is the question of *Public Water Supply.*

The well-being, comfort, health and life of the human race, is more closely identified with, and involved in, the *quality* of the water used in our domestic economy, than in any other—perhaps all other causes combined.

I speak here in a general sense relative to *public* water supply; as only in this sense has the engineer very much to do with the subject, *practically*; yet I wish to treat the subject fully and comprehensively, in both its *public* and *private* bearings.

I wish it understood also, that the question of *Public Drainage* is included as a part of my subject.

Public drainage is made more necessary, indeed almost *compulsory*, by the introduction of a public water supply, but public drainage is not posssible without the aid of public water supply, so that the two questions naturally and properly go together, and should be treated under one head.

I believe that more *ill health*, *sickness* and *death* results from bad water supply and bad drainage, than from all other causes combined.

Disease germs abound in a thousand fold greater proportion in the water we drink, than in the air we breathe, and are far more dangerous taken into the system with the water, than with the air. I very much doubt whether disease germs are *primarily* produced in the atmosphere at all, but these germs are doubtless taken up by the atmosphere from the water, and thus conveyed into the human system in the air we breathe.

In low, marshy districts, where the waters are always loaded with decaying vegetable and animal matter, with all conditions in the highest degree favorable to the production of "*bacterium*," the most minute microscopic disease germs known, the atmosphere is very much of the time dense with fog and moisture. In absorbing this moisture from the *stagnant*, *steeping* waters, doubtless, vast numbers of these minute disease germs are taken up; so that in such localities, both elements, the air and the water unite in their attack upon the health and lives of all who live in such places; hence, the world over, such places are the most unhealthy.

In the temperate zones, where frost arrests fermentation and decay for several months each year, the diseases produced by this agency assume comparatively mild forms; but in the tropics, and especially among the dense population of Hindostan, where this ferment, putefaction, decay and germ developing process is *forever* at work, the result is frightful. Here all the terrible plagues that have afflicted the human race since the dawn of creation, are fomented, and start out on their tours of world-wide devastation. The terrible destructiveness of these periodic plague epidemics is vastly enhanced by the *fears* and *ignorance* of mankind. When a plague starts out on its tour of devastation from its *Asiatic birthplace*, all the people in its pathway become panic stricken with fear, indeed thousands dying from fear alone. It is at once accepted as true, by the mass, that the moment a case of *plague* or *cholera* appears in a place, the entire atmosphere is tainted, and everyone in danger.

I believe the truth to be, that a case of plague or cholera cannot be communicated through the atmosphere, except possibly in wet, filthy localities where the atmosphere is always dense with moisture, and even then perhaps, only when the disease is largely prevalent there.

I think that cool, calm, critical investigation will show that *personal contact* is necessary; that the germs of the disease must be taken into the system before the disease itself can be produced.

Strangely enough, the last place from which this enemy is looked for, is in the direction of its almost invariable

approach, namely, through the medium of our drinking waters.

Water is the *natural developing place*, and *home* of all these disease germs; and water is among the first and most necessary elements of human existence, and yet the average human being is more careless concerning the *quality* of the water he uses than about anything else in his daily life. That which most vitally concerns his well being he, through his ignorance, gives slightest attention to. If we can so educate the people that these things can be *seen* and *understood* in their *true* meaning, then, and not till then, will the question of public water supply receive the attention and treatment its great public importance calls for.

The term *public* water supply is generally understood as applying only to cities, villages, and other large communal aggregations, where a general system is designed to provide for the wants of the entire community; but if we confine ourselves to this view, we leave entirely out of the consideration by far the greater part of all the people.

Except in a very few of our larger cities, by far the greater portion of even our *urban* population obtain their water supplies from *private* sources, almost invariably the ordinary private well, this source being almost *universal* among all *rural* populations. The waters of the ordinary private wells are the most *impure* and *dangerous* waters that we can use; all the more dangerous because of the almost universal *belief* in their purity and excellence.

In this city (*Lansing*), in *Jackson*, in *Kalamazoo*, and indeed in every city in the state except Detroit, more people patronize the *deadly private wells* than patronize the public supply, regardless of the character of the water. Jackson, with 25,000 people, and a public water supply system inaugurated twenty-three years ago, to-day only supplies about 8,000 of her people with water from the public source, leaving 17,000 still wedded to the *poisoned* water of their private wells.

Kalamazoo, with about the same population, and with one of the finest and most excellent water supplies in the world, yet only supplies *two-fifths* of her people from the public source, all the rest taking their supply from the *poisoned* wells.

The chief reason why the people are so slow to discard their

private wells and adopt the public supply, arises from the fact that the almost universal belief seems to be that the ordinary private well furnishes the *purest* and *best* water to be obtained from any source. Another weighty reason may be found in the fact that most of our public water supply developments are so *crude* and *imperfect*, and our water works plants so *inefficient* and *unsatisfactory* in service that the people very largely prefer to keep in the *old channels*.

In proof of the correctness of this view, we may refer to the two cities of Kalamazoo and Ypsilanti. Kalamazoo, with a *perfect* water supply, so far as *quality* goes, and a water works system inaugurated twenty-four years ago, has to-day only 1,800 service connections with her Public water mains, representing only *9,000* of her *22,000* people. Ypsilanti with a water supply of similar quality, and a water works plant inaugurated only *three* years ago, has to-day over *900* service connections, representing *4,500* of her *6,000* people as using the public water. This shows that the *quality* of the public water supply *service* is more important in the public estimation than is the *quality* of the public *water supply*, and that it is well nigh impossible to bring the people into full and general patronage of a public service of such *low grade* as furnished by water works systems of the *Kalamazoo* and *Jackson type;* and four-fifths of all the water works systems of the country are of this inferior type. The only way to change this order of things and place this all important question of public water supply upon a proper footing, will be to educate the public up to a proper knowledge of what a proper public water supply *is* and *means*. Not only must the public be educated up to a true knowledge relative to the *quality* of the waters used and the vital interests involved, but *practical* workers in this field—often only *pretenders*—must be educated up to a higher conception of the "MECHANICS and ENGINEERING" involved.

One of the greatest obstacles we will encounter in this educational crusade, will be the popular faith in the purity of our private well water supplies. To overturn this popular faith will prove an herculean task, all the more so from this wonderful fact: This faith *is primarily well founded*. It is only through the fault of the *mechanics* and *engineering* involved that all the

mischief and danger arises. The *prime* source of the water supply of our private wells *will* furnish the *purest* and *best* water obtainable from *any source*. It is only in the *mode* of development *and utilization* that we are all wrong. *Nature's* process of filteration in the strata of "*Mother Earth*" is far superior to anything that man has yet discovered, or probably ever will discover. In taking our water supply from the *ground*, we must take it from comparatively near the surface, as if we go very deep, we usually find the water so highly impregnated with mineral matter as to be unfit for domestic use. On the other hand, we must *never* take it from *above* the *danger line* of *surface contamination*.

In all cases where the rainfall penetrates the earth and percolates through its strata, these waters in their downward passage become contaminated by largely absorbing the impurities of the atmosphere, and of the vegetable and animal matter encountered, so that we will almost invariably find the *upper levels* of the first subterranean water stratum more or less contaminated with *organic* matter. But right here comes in NATURE'S grand saving clause. It is found that in these *fixed* and *permanent subterranean* water strata, the water never becomes contaminated but to very *slight depth* by organic matter, all this matter being held in suspension *at* or *near* the surface of the water stratum, very much as oil and other lighter matter is held at the surface; so that to obtain *good* water all that is necessary is to go below this thin stratum of *bad* water, and yet not so deep as to encounter the mineral impurities below. In this way every private or public well in the land may be made perfectly safe, if located in a water bearing stratum of adequate thickness or depth.

As now constructed, nearly all these wells only slightly penetrate the water stratum, simply *skimming* their supply from the extreme *surface* of these waters, thus, of course, getting the *cream* of all these *contaminations*. The fact that the organic gases which poison the waters of our private wells, do not affect the *taste*, *looks*, or *smell* of the water, unless present in gross form, renders it all the more difficult to convince the average observer that such water is *dangerous*.

It is the prevalent belief of most people that the water of

their own wells is exceptionally good. As they draw up the "*old oaken bucket*" and drink of its sparkling waters, it is natural to revert, with grateful feelings, to the beautiful sentiment that inspired the production of that old poem. But place a sample of this same sparkling water under the glass of a powerful microscope and what you will see there will speedily banish all romance and sentiment.

Our cess pools and privy vaults and defective drains, are the most dangerous sources of contamination for the water of our private wells. The disease germs in such places are the most dangerous that can be taken into the human system; and if the drainage of these places reaches our drinking water wells, even if in ever so slight a degree, these germs surely will be taken into the system.

The popular belief that twenty-five, fifty or one hundred feet of intervening earth between our cess pools and our wells furnishes ample protection, is entirely fallacious. A little, plain, homely, practical truth will go much further in dispelling this illusion than will whole volumes of theory and metaphor.

This was very clearly illustrated in the experience of the city of YPSILANTI in developing her public water supply and drainage systems. While planning and constructing these works, I tried in every way to impress upon the minds of the people the danger lurking in the waters of their private wells, and the necessity for connecting with the public supply. Very few could be made to believe that the water of their wells was bad, the prevalent belief being that it was exceptionally good. Least of all could they be made to believe that there could be any danger of contamination from their cess pools and privy vaults.

In constructing a trunk line sewer through the finest residence portion of the city, it was found necessary to go several feet deeper than the neighboring private wells with this sewer trench. Within a very few days every well within two blocks (*750* feet) was *drained dry*. After this, it was not difficult for these people to *see* and *believe* that where the water of their wells could so quickly find its way to this sewer trench, through 750 feet of intervening earth, certainly the fluid contents of their cess pools, seldom fifty feet away, could very easily reach their

wells. Had these same private wells been ten feet deeper, and so constructed that water could enter them only through the *bottom*, all danger would have been averted.

I will dismiss the subject of private wells with this observation: If the instructions outlined above are followed, every private well may be made perfectly safe.

To go back to the main subject, *public water supply*, while we find nothing involved very different in principle, yet we find the question far more difficult of treatment. In a private supply, we usually have only the limited requirements of individual cases to provide for; in a public supply, we have the collective whole on our hands.

In almost all localities, we can easily find water enough in the ground to supply a private family of five or ten persons, but when we come to a public supply, involving the needs of five thousand, or five hundred thousand people, it seems a very different thing, and yet it is different only in relative proportion, and it is very rarely that we find the obstacles to success insurmountable.

I have a religious faith, that wherever the ALMIGHTY has ordained that human beings shall find an abiding place, HE has provided within easy reach, every requisite for their comfort, and chief among these requisites, is *good water*.

But very often we *disobey* all God's *sanitary* laws, and thus bring endless suffering and misery, where *obedience* would have brought peace, comfort and happiness.

Many of our cities are to-day poisoning their people, through the agency of corrupt public water supplies, developed in partical or total disregard of all natural *law* and *principle*; many other cities with water supplies ample in *quantity*, and excellent in *quality*, often wantonly poison these excellent water supplies with notoriously bad water, upon every little fancied emergency, and thus keep the health and lives of their people in constant danger.

The city of *Jackson*, with a most excellent public water supply of three million gallons of water per day, while her consumption is only half this amount, yet turns the waters of a foul disease, germ-laden stream into the water mains and service pipes of her public water system, perhaps fifty or one

hundred times a year, or as often as they happen to have a fire.

The only necessity for this terrible and inexcusable practice is entirely due to the *low grade* of *mechanics* and *engineering*, as exhibited in the *development* and *management* of the Jackson water works system.

It is doubtless true that the great majority of our officials on "Boards of Public Works," are honest, and aim to perform their duties faithfully. The chief trouble arises from the people themselves, electing *incompetent* men to serve them in these important places.

A man may be a good shoemaker, a good blacksmith, doctor, lawyer or minister, but the chances are that not one of all these would be in the slightest degree acquainted with the *mechanics* and *engineering* involved in a public water works development. Often some of the least competent of these people are placed in positions of authority upon such boards, and *assuming* to *know*, will perhaps work more mischief in one administration, than a dozen succeeding administrations can undo and rectify. The poor, patient, deluded tax-payers, however, uncomplainingly foot all the bills.

Doubtless, the most striking instance of inefficiency, gross mismanagement, and reckless waste of almost *matchless natural advantages*, is afforded by my own home city, KALAMAZOO, in the management of her public water works system. I should prefer not to use this case in illustration, could the same end be accomplished, and the same good be done otherwise, because everything connected with the Kalamazoo situation is in some degree *personal* to myself; but it is only the *public* good that I desire to promote, and this means the *Kalamazoo public good*, as well as the general public good.

In a case like this, the plain, unvarnished *truth* constitutes what may be termed *heroic* treatment, and such treatment is the only possible way to reach such cases, and accomplish any good.

Kalamazoo has one of the finest public water supplies in the known world, and yet this splendid water supply is so managed, as to be, oftentimes, well nigh worthless.

Twenty-two years ago I developed this water supply, for the then village of Kalamazoo.

This supply is taken from the ground by means of a large well, twenty feet in diameter, and thirty feet in depth, this being the *first* large public water supply ever developed in this manner. Neither the *engineering profession*, or the *public*, had any faith in the feasibility of this enterprise at the time, and it was only after I *guaranteed* the *engineering success*, and *advanced half* of the estimated *cost* from *my own pocket*, that the village authorities permitted me to go forward with the enterprise. The result of this *pioneer* experiment far exceeded my most sanguine expectations. When the work was completed, we had a well that would furnish *three* and *one half million gallons* of *water per day*, and this water was so beautifully *clear* and *transparent* that a nickel could be *plainly seen* on the *bottom* of the well, through a depth of *twenty-seven feet of water*. This marvelous well will to-day, after *twenty-two years constant use*, still furnish three and a half million gallons per day, of the same fine quality of water, and yet the *management* of this splendid water supply is so *bungled* that the city is kept almost constantly on the *danger line of water famine*, and her people in an almost *constant panic* of *fear*. What a comment upon municipal *mismanagement*, in a city with a water supply of *one hundred and seventy-five gallons per capita per day* for her *entire population*, and while supplying only two-fifths, her people is in almost constant fear of a *water famine*, and to meet emergencies, makes provisions to admit the water of a *sewage polluted stream* into her water mains, thereby *poisoning the entire water supply*, and *endangering* the *lives of all her people*.

London, *Liverpool*, and other large European *cities* find that *twenty-seven* to *thirty-five* gallons per capita per day is an ample supply of water for *all purposes*, and this where the *entire population* are consumers. Yet *little Kalamazoo*, with a supply of 175 gallons per capita per day for *all her people*, cannot manage to properly take care of *half of them*. Comment is unnecessary. The whole secret of this miserable situation is simply this: Kalamazoo and all similar water works systems, in their arrangement, simply live from *hand to mouth*, with no possible provision for *emergencies*. While she has at command at *all times* three and one-half millions gallons of water per day, she

cannot at *any time exceed* this rate for a *single half hour*. Yet she has placed herself in a position where she is liable to be called upon for water at *any moment*, at the rate of *seven* or *eight* million gallons per day. As an engineer, I maintain that it is *criminal* to assume such *liabilities* and *obligations* without making *adequate* provision to *meet them*.

To make such provision at Kalamazoo is exceedingly easy; and while such improvement would make everything safe and in the highest degree efficient, in *every branch* of the *public* and *private* service, it would at the same time greatly *reduce* the *cost* to the *tax payer*. At Kalamazoo, with a water supply of three and one-half millions per day, and a pumping capacity of six millions, it is not possible to exceed the three and a half million rate for even a single half hour for any or *all* service. With a small storage reserve, such as the *natural* advantages at Kalamazoo will afford at the *minimum* of cost, water at the rate of *ten* or *twelve million gallons per day* would be *always* at command for any *emergency*, and for as long a time as such emergency is ever likely to last, and this without any *increase in the present supply*. And the *quality* of the water will not be at all *impaired* by this *storage reserve*.

Under such an arrangement *every branch* of the service will be *incomparably superior* to what it is *possible* to make it *now*, and all danger of *water famine* will *forever disappear*.

The city of Ypsilanti, in her public water supply development, furnishes a perfect illustration of the truth of all this, and every feature there has been fully and completely *demonstrated* in *practical use*. Ypsilanti has an excellent public water supply of two million gallons of water per day. She has only one-fourth the population; yet in three years time she has *one hundred per cent more* water takers in proportion to population than has *Kalamazoo* in twenty-four years; and her consumption of water is in excess in the same proportion.

Ypsilanti has a maximum pumping capacity of only two million gallons per day, yet at *any time* and at *all times*, whether her pumps are *running* or *idle*, she has always at *command*, water at the rate of *eight* or *ten million* gallons per day for *any* and *every emergency*, for so long a time as such emergency is ever likely to last.

Every gallon of this water is always under *one hundred pounds pressure* to the square inch, at pump datum, and is thus available at *all times* for the highest and best effect in *every branch* of the *public* and *private* service. These works have reached a self sustaining basis in three years from date of construction. In the Kalamazoo and Jackson systems, the water pressure in the mains never exceeds an average of *thirty pounds* unless specially called for and worked up *after* the *alarm* is sounded. This low pressure is never efficient or satisfactory in *any branch* of the service. In these works, if the pumps stop an instant at any time, or from any cause, the entire service, in every branch, is *instantly dead* until they start again.

In the Ypsilanti type of works, the pumps may *stop entirely* for *six* or *eight* hours in every twenty-four, and yet every branch of the service will go on precisely as if the pumps were running. Indeed, this is precisely what does happen every day at Ypsilanti. At night the pumps are always shut down, and the pumping power is transferred to the electric dynamos, and thus utilized to run the electric street lighting plant. The Ypsilanti type of public water supply as far surpasses the Kalamazoo and Jackson types in *economy* as in efficiency. The Ypsilanti works reach a self sustaining basis in *three years*; Kalamazoo and Jackson, with not better than a *fifth rate* service, are still, at the end of *twenty-three years*, *thirty thousand dollars behind each year.*

These cases ought to convincingly show how very important and *necessary* it is to adopt *correct principles* in the planning, construction and management of our public works, and more especially as relates to public water supply improvements.

Ypsilanti, at the end of three years, is directly supplying *seventy-five* per cent of her *entire population* with water from her public works, and everyone is entirely satisfied with the service in every branch.

Kalamazoo and Jackson, after *twenty-three years*, are only supplying about *thirty-five per cent* of their population from the public source, and very few of these are satisfied with the service in any branch.

These cases ought to conclusively show the great impor-

tance and necessity of good engineering and good management in this grand field of public work, and that satisfactory results are not otherwise possible.

I have freely used the above named cases in illustration because I am perfectly acquainted with every detail in each of these cases, and because I believe the *public interest demands* this information, and that it is the clear *duty* of the *engineer possessing it* to furnish it.

In the main, all the defective points cited in the Kalamazoo and Jackson cases, will apply to all works of that type, and I feel that it is the duty of the *true engineer* to do his utmost in eradicating these defects.

As before remarked, we cannot do full justice to the question of public water supply, without including the question of public drainage; but I am occupying so much time with water supply that I do not feel justified in devoting much time to the discussion of public drainage, at this time, and will only indulge in a few general remarks on this subject.

I believe it to be of the highest importance, and among our first *duties*, to provide efficient house drainage *everywhere*—in city, in village, and in the country.

Surface or storm drainage, and house drainage, should always be kept separate and distinct. A house drain and a storm drain combined, is a monstrous blunder, and brings endless danger.

The true object, and office of a house drain, should simply consist in the *quick* conveyance of all the filth produced in and about the house safely beyond the *danger limits*.

All house filth is comparatively harmless in its fresh state, and if disposed of before fermentation and putrefacation takes place, nearly all danger is averted; but if we allow this filth to accumulate in cess pools, privy vaults, and other places about our dwellings, we simply leave the door wide open, and *invite* every danger and disease.

If we permit this filth to accumulate, and be stored about our premises, and to be in constant process of fermentation and decay, we are establishing precisely that condition which will most effectually poison the air we breathe, and the water we drink; and at the same time *preserve*, *reproduce* and *perpet-*

uate, the disease germs given off by every case of *sickness* and *death* ever occuring on these premises.

Had this filth been properly disposed of as fast as made, then no *later occupants* of these premises would ever be endangered beyond their *own individual responsibility*.

Both public water supply and public drainage are vital public necessities, but we cannot establish and maintain public drainage without the aid of public water supply. This fact greatly enhances the *primary* importance of public water supply.

I believe this to be true in our situation to-day, that all that is necessary to secure the highest effectiveness and most widely beneficial results in both these grand fields of public work throughout our entire land, is to educate the public up to a true knowledge and understanding of this grand field of work and its requirements.

THE PRESIDENT: This paper discusses a subject which is fast becoming one of the utmost importance in this country, and contains much that is worthy of the serious consideration of the members of this Society. Mr. Coats' theory that the boundary line between good and bad underground water is a very narrow one is not generally understood nor accepted. It is a very important one if correct, and it is to be hoped that at our next meeting Mr. Coats will give us the facts upon which he bases it. The language of this paper may appear to be occasionally severe, but Mr. Coats distinctly disavows any intention of reflecting upon any member of this Society or of the engineering profession. His criticisms are directed solely at the imperfections of the system of water supply which depends solely upon direct pressure without storage.

WATER WORKS AT SOUTH HAVEN, MICH.

GEO. S. PIERSON, ENGINEER.

The city of South Haven lies on the shore of Lake Michigan at the mouth of the Black river. It is a place of about 2,500 inhabitants. The larger portion of the city, including most of the business blocks, lies on a plateau south of the river and close by the lake. About one-third of the city occupies a similar plateau north of the river. The portion of these plateaus occupied by buildings lies at an elevation of thirty or forty feet above the level of the lake.

South Haven has within a few years suffered two disastrous fires, and about a year ago voted bonds to the amount of $35,000 for a system of water works. This amount was subsequently increased to $40,000, a portion of which was expended in the equipment of a fire department and the extension of lines of water pipe not originally contemplated.

The water supply is derived from tubular wells on the lake front and is forced into a stand pipe located near the business portion of the city, and standing on ground about thirty-five feet above the level of the lake.

Aside from the method of obtaining a water supply there is nothing about the system particularly interesting to engineers, the details being, in the main, similar to those in other works of this class.

Attempts had previously been made to secure water from the strata bordering the Black river at points above the city, but without success. A suitable supply could be obtained from the lake by a long intake pipe extending out beyond the bars, but the estimates for this intake pipe, protected from the action of storms, which are severe at this point, were about $10,000. This sum, added to the cost of the stand pipe and pumping plant, left very little of the appropriation to be applied to the construction of pipe lines. The problem, then, was to secure at less cost a supply of water sufficient for present needs which could be supplemented in future as the demand arose, at reasonable cost and with certainty.

An examination of the lake shore revealed the following conditions:

The bed and shore of the lake is sand, rather fine, but well washed and permitting the passage of water with reasonable freedom. The shore rises from the lake at a slope of about three feet in 100 to the foot of the bluff, which is about 400 feet distant. The bluff, with the exception of a surface covering of about three feet of sand, is of tenacious clay as deep as it has been explored. The same clay formation extends under the beach of the lake at a depth of eight or ten feet below the surface of the sand and, continuing, extends under the bed of the lake at about the same depth.

Test wells were sunk at various points in the beach to the level of the stratum of clay, and from their behavior the following conclusions were drawn:

1. There was a slight upward inclination of the water surface from the level of the lake toward the foot of the bluff and consequently a movement of water from the sub-surface underlying the city towards the lake. Chemical analyses of the water from a series of wells arranged at right angles to the lake shore indicated that the water in the upper portion of the beach was polluted, and that the degree of pollution was less as the lake shore was approached.

2. The sand was sufficiently free to admit the passage of water in considerable quantities.

3. Vertical tubular wells of the ordinary form sunk in the shallow layer of sand above the clay must necessarily have short screens placed just above the clay in order to prevent the taking of air by the pumps when the water stratum is lowered by continuous pumping; and since a gang of wells in order to supply a sufficient quantity of water from this stratum must be at considerable intervals, it follows that the relative proportion of connecting pipes to screening surface must be large.

4. The farther from the bluff a supply of water could be secured the purer would the water be.

The following method of obtaining the supply was adopted:

At points thirty feet back from the water line of the lake pits were dug to water. Starting from these pits six-inch tubular wells were pushed out under the lake nearly horizontal, the in-

clination being about one inch per foot downward. This is about the inclination of the stratum of clay underlying the bed of the lake. Where the tubular wells pass under the shore of the lake they are about three feet deep, and the depth below the sand gradually increases to five or six feet at the distance of about 125 feet. At about this distance from the shore line screens thirty feet long and as large as can be inserted in the six-inch casing are set. There are three of these wells at present and they are twenty-five feet apart and are connected by pipe lines parallel with the beach into a twelve-inch suction line leading to the pumps.

The history of subterraneous water supplies records many failures. The natural conditions essential to success are

1. A sufficient water shed from which the sub-surface water naturally flows to the point of supply or may be drawn to it by pumping.

2. Porous strata, both at the point of supply and remote from it, through which the sub-surface water may pass to the point of supply in sufficient volume.

The determination of the extent to which these conditions are present is generally a difficult matter. The action of test wells when pumped for a limited time is no guarantee of their performance under continuous pumping, and the fact that one test well supplies a certain quantity of water in a certain time is no guarantee that we can duplicate it by others at invervals of 50 or 100 feet or more which will correspondingly increase the supply even for a limited time; and if they do so for a limited time it may be that all are in a pocket of limited area which will be exhausted so much the sooner.

In the case in point, however, many of the uncertainties surrounding a work of this class are removed. The stratum in which the screens lie is comparatively accessible for examination. There is every reason to believe that it is uniform in character. Lake Michigan, which determines the static head above the screens will, so long as it stands above them, insure a constant supply of water to them, limited only by the capacity of the screens and the five feet of sand above them to convey it. Furthermore, wells placed at no great distance from one another horizontally will not sensibly encroach upon each other,

being supplied along the lines of least resistance or mainly through the sand *above* the screens. The supply can therefore be increased with certainty by additional wells.

If the lake recedes so as to uncover the screens, or the beach extends so as to force the open water beyond them, the wells can readily be extended, or additional ones can be put in to make up for the increased resistance due to the passage of the water through the sand for a greater distance.

The pumps are placed on foundations only seven feet above the level of the lake, in order to make the lift as low, and the action of the pumps as smooth as possible. The three wells readily furnish one million gallons of water per twenty-four hours under a vacuum of ten inches, as indicated by a gauge set on an air chamber thirteen feet above the level of the lake. The air chamber is taken off the suction line at a point seven feet above the level of the lake. Correcting for the lift of the pumps, and the friction in the suction line, the vacuum necessary to induce the passage of one million gallons of water per day through the sand and screens, is about two or three inches of mercury, or, say from 2.25 to 3.4 feet of water.

The water is uniformly clear, even during severe storms. No deposit of fine sand particles can be detected after the water has stood in a deep vessel for some time.

It was anticipated, that possibly the sand about the screens might become so compact by the action of the waves and the ice in winter as to impede the passage of water through it, and a by-pass is provided around the pumps so that the stand pipe pressure may be put upon the screens, and the current through them reversed. Each well is provided with a gate, so that it can be isolated from any, or all the others at will.

In the pump house are two direct acting duplex pumps of the Hughes pattern, each having a capacity of seven hundred and fifty thousand gallons each twenty-four hours.

There are two boilers fifty-four inches by twelve feet, with the usual attachments. Coal oil is used as fuel. It is stored in a special tank near the pump house, from which it is brought to the boilers by a pump. On the supply pipe from the oil tank is a meter. The flame from the burning oil strikes

against a bridge wall of fire bricks at the front of the boiler, which is laid up without mortar, and the bricks spaced about two inches, so that a portion of the flame passes through and against other similar walls. These bridge walls not only distribute the heat along the boiler with less damage to it, but after the fires go down, have a marked influence in keeping up the steam by the heat which they give off. The pumps are run about an hour each day, in the afternoon. Morning and evening, oil is burned under the boilers for about ten or fifteen minutes, and this prevents the steam pressure falling below thirty pounds at any time during the twenty-four hours.

The arrangement of the distribution system is shown on the accompanying map. The main leading from the pump house is ten inches in diameter, and the main connecting the stand pipe with the balance of the distribution is also ten inches in diameter. All hydrants except one are off from lines six inches in diameter or larger, and this one is fed by a four inch line from both directions, which is reinforced at the distance of a block in each direction by a six inch pipe.

Where the water main crosses Black river, it is laid fifteen feet below the surface of the water. It was desirable to test the river crossing before connecting it with the balance of the distribution system, and the following method was adopted.

The pipe was closed at one end above the water by a gate, and into the other end was calked an iron plug. Into this plug a ¾ inch water pipe was tapped, having a water meter and water gauge attached. Water was forced into the river crossing through the ¾ inch pipe, and the meter attached to it by a force pump until the desired pressure was obtained, and then the pump was operated enough to preserve this pressure. By this means could be detected the leakage in a given time at the required pressure.

The following lengths of pipe of the different sizes have been laid.

12 inch,	138 feet.
10 "	2646 "
8 "	3841 "
6 "	18420 "
4 "	4420 "

There have also been laid 2,705 feet of wrought iron pipe for domestic users only.

There are sixty-three hydrants. Some of those in the business portion of the city have independent nozzle cut off.

The stand pipe is fifteen feet in diameter, and one hundred feet high. The lower twenty feet is made of steel ½ inch thick, and at each twenty feet the thickness of steel is reduced 1-16 of an inch, the top course being ¼ inch thick.

The cost of the completed system was about $35,000.00.

MR. WILLIAMS: Do the ends of the tubular wells lie in the [sand?

MR. PIERSON: Yes, under the sand.

MR. WILLIAMS: How did you force them out?

MR. PIERSON: With jack-screws.

MR. WILLIAMS: What sized pipe did you use?

MR. PIERSON: Six-inch.

MR. WILLIAMS: How far below the water is the pipe?

MR. PIERSON: About five or six feet below the bed of the lake.

MR. WILLIAMS: What are these screens attached to?

MR. PIERSON: Pits were first dug, and from them pipes driven out into the lake by jack-screws; after the casing was driven out to that point, the screens were then inserted. Then the casing was drawn back, leaving the screens exposed.

MR. ROGERS: What was the expense of sinking these wells?

MR. PIERSON: The contract price was for $3,000, guaranteeing a supply of three-quarters of a million gallons in twenty-four hours.

MR. ROGERS: How was the river crossing laid below the bed of the river?

MR. PIERSON: The bed was dredged, and the pipe was laid with flexible joints. The pipe was all put together above the water and lowered to its place.

THE PRESIDENT: Did you complete your dredged channel all the way across before you laid the pipe?

MR. PIERSON: Yes, all the way across.

THE PRESIDENT: You did not have much current to contend with?

MR. PIERSON: Very little.

STREET GRADIENTS.

A. L. MARHOFF, BATTLE CREEK.

MR. MARHOFF: [This question has attracted my attention during the last summer more than any other question, from the fact that the city of Battle Creek, of 13,000 inhabitants, until last spring, had no person, who by ordinance or appointment could be called "City Engineer," and of course the streets, as regards grades, were in a very bad condition, only a very few grades having been recorded, and those of about twenty years standing.

I had no idea of edifying the members, in presenting this paper, but do so with the hope of getting information from those that have this work to do.]

Without a doubt there is no one thing entering into municipal engineering that affects the free holder and citizens of any municipality as the fixing of new grades and changing old grades that have become fixed by long usage. It no doubt has occupied the careful consideration of the older members of the profession as well as puzzling the younger members to a greater or less degree.

One of the most perplexing parts of the problem to the engineer is the part relating to intersections, including the elevations of block corners. While the part affecting the lot owner is the amount of cut or fill at the place of his abutting property, which from the nature of the case must receive the careful consideration of the city engineer. Where a city is located in a comparatively level section the problem is very much simplified.

There are three main objects to be attained: First to remove the surface water as soon as possible, second to reduce the percentage of grade to the least possible minimum without material injury to adjacent property, and third to make a street present a good appearance.

To accomplish the first, one should not have a minimum

grade of less than 3-10 of one per cent only in very extreme cases unless the street is paved with brick or asphaltum.

The second case should be governed very largely by the location and nature of the improvements that have been made along the line of the street. On a steep hill side where no improvements have been made to any great extent, or no improvement of any kind, a large cut will be admissible; but if the buildings and other improvements are of a permanent nature before the grade is established, as is too frequently the situation, one is almost, if not quite, compelled to accept the circumstances and make the best of the surroundings. It is therefore of great importance to all concerned to have a grade established and recorded as soon as possible after a street is laid out; then all improvements can be made to conform to said established grade.

The last and by far not the least is to have such a grade established as will give the street a good appearance. This part of the problem is governed largely as to whether the street is in the business or resident portion of the city. In either event the curb line should if possible be unbroken from CURB CORNER to CURB CORNER, but if impossible the grade should change at some property line, and if the change is very abrupt there should be adopted what might be called an easement grade, to prevent as much as possible a large deposit of sand and other easily moved material. By this means the trouble of continually removing the deposit after large showers could be greatly averted. This easement grade is of as much assistance in lessening the expense of caring for a street as are easement curves in railroad work in caring for the track and rolling stock.

And finally we have the street intersection problem, which has almost as many ways of solution as there are engineers engaged in municipal work. I find a very common way of disposing of it is to make all curb corners the same elevation. This has its advantages as well as its disadvantages. The only thing that seems to commend it is that it is an easy way of solving the problem, while it has the disadvantage of failing in being satisfactory on account of lack of drainage, unless what might be termed a compromise grade is adopted, which makes the finished work look as if the whole thing was done

by guess. A flat intersection also presents an ugly appearance, especially on a steep grade. Imagine yourself ascending a six per cent grade and when part way up, meeting with thirty or forty feet of level grade. It will invariably have the appearance of a descending grade. The best solution for resident portions of the city seems to be if the grade is three per

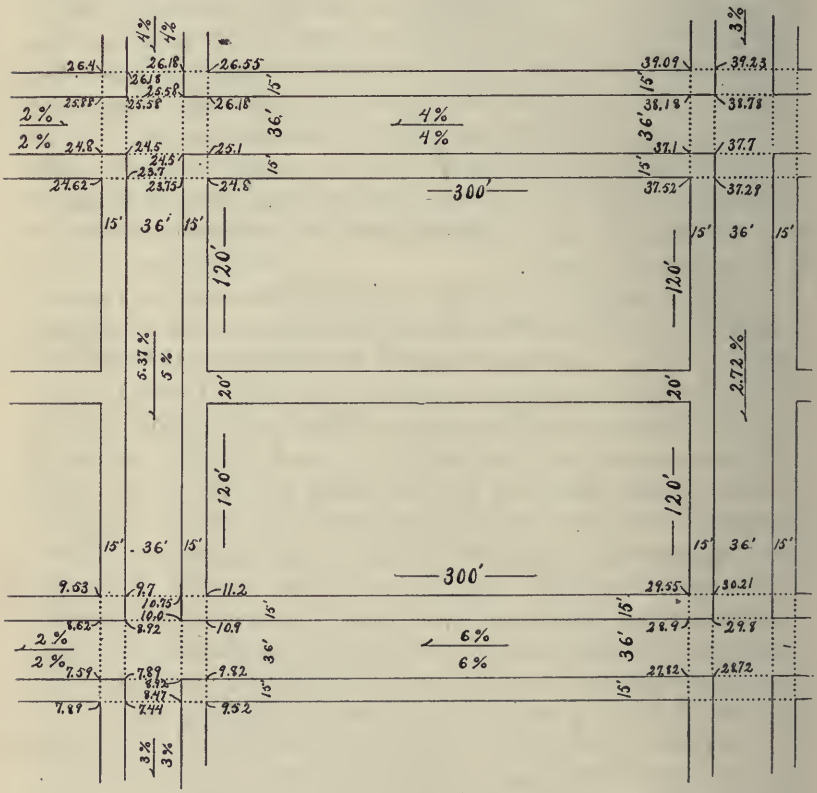


FIG. A.

cent or less, to carry the grade to the center of the intersecting street and make the change, if any, at that point, otherwise change the grade at the curb corner and making the maximum grade for the intersection three per cent. In the business portion of the city the maximum grade for intersection should for various reasons be less than three per cent. The elevation of block corners should in all cases be found by tak-

ing one-half of the sum of the two elevations of the curbs opposite the block corner, plus twice the elevation desired for a block line above the curb, which should be estimated at a 2½ per cent grade. For example: The elevations of the curbs opposite a given block corner are 10.75′ and 10.9′ respectively, and the curb line is fifteen feet from the block line, at 2½ per cent grade; this would make .375′, twice which is .75′. The sum of 10.75′ + 10.9′ + .75′ = 22.4′, which divided by 2 gives 11.2′, then 11.2′ would be the elevation of such a block corner.

The accompanying map (*Fig. A.*) shows a good way of recording such grades as well as better illustrating the plan.

Mr. Teed: In his paper, Mr. Marhoff names over the requisites for street grades. and puts the appearance of the thing last. Now, I have been making street grades for about twelve years, and I find that after twelve years lapse of time those streets give the most satisfaction to the public as well as to myself, so far as I have any means of ascertaining, where we make the third requisite the first. I always aim, first to make the street look well, then figure the cost, and then the convenience of the people on the street—that I would put last, and of course if they don't object I don't take that into account at all, and if they do object, they have got to put it before the council, and before they get the matter through the council, their objection keeps growing smaller, and after the street is graded, and the people have the buildings raised up to the street, they forget the trouble and bother, and those streets that have been laid out with the first requisite—the general appearance of the street, are the streets that give the best satisfaction to-day.

I am thinking of residence streets of course, and that being the case, I would make no break at all with cross streets, and if cross streets come in, twist the ends so as to make the sidewalks fit. Fix it up to make it look as well as possible.

Mr. Sellers: What is your minimum grade?

Mr. Marhoff: Three-tenths of one per cent. What is the custom with reference to carrying the intersecting street back where you meet quite an inclination?

Mr. Sellers: The least minimum that I have been able to use is 5-10 of one per cent.

THE PRESIDENT: I don't suppose there is any established custom among engineers—each one has his own way. My practice was, to take the important streets, get as nice a grade as possible, and fit the cross street in as well as possible. I never could follow the same rule with regard to any two streets.

MR. GRANVILLE: Sometimes in carrying a grade up one street, especially where the grade is heavy, you finish your street and it has a nice appearance; but when you attempt to finish a cross street, which perhaps is just as important, you cannot make it present the same finished appearance. Another thing—I think the flat or level intersections are all right. They are good breathing places, and it gives you a better chance to finish most streets. It may be necessary to leave the block corners on the upper side of the hill higher than on the lower; but unless the grades are very heavy, it seems that nearly all intersections can be made about level.

THE PRESIDENT: I was speaking only with reference to streets having very heavy grades. The trouble is in first laying out our cities—instead of going straight up a bluff, the road should slant.

MR. SELLERS: What, as a usual thing, is your rule with regard to the width of a roadway?

MR. MARHOFF: From top to top of gutter, we make it thirty feet.

MR. ROGERS: Another question comes up right here: I think that cities lay out a good many streets at a needless width. A width that the traffic of the street will not demand for years, and thereby materially increases the cost of the pavement and cost of repairs, when a narrower street would answer all purposes.

MR. MARHOFF: That would be very well if you took only cost into consideration, but it is vastly more healthy to have wide streets, and a circulation and pure air, and safer in case of fire.

MR. ROGERS: I believe in having streets as wide as we can get them, but leave a lawn between the sidewalk and the curb.

MR. SELLERS: The question was with me, are they ever

made narrower than thirty feet, and if the rule is wider, I want to know it.

MR. GRANVILLE: In Saginaw, the majority are sixty-six feet in width. By ordinance, the earth streets are made with sidewalks fourteen feet—that would give us thirty-eight feet from the top of the ditch, as you term it, on one side, to the top of the ditch on the other side, leaving probably twenty-six to twenty-eight feet for the road bed proper. Of course, when it comes to paving or graveling, the widths are changed.

MR. SKEELS: In Grand Rapids the sidewalks run from twelve to sixteen feet, and fifty foot streets are the rule, with ten foot sidewalks.

DIGEST OF LEGAL DECISIONS.

The following digest of legal decisions of interest to engineers is compiled from the reports published by the West Publishing Company, by permission:

ADVERSE POSSESSION.

1. To entitle a party to claim by adverse possession he must have made an actual entry upon the lands and occupied the same as owner, but such occupancy may be continued by his agents and servants.—Omaha & Florence Land & Trust Co. v. Parker, (Neb.) 51 N. W. 139.

2. In an action for partition of lands descended, a son-in-law of decedent set up title to a part of the lands occupied by him by adverse possession, and that the same never belonged to decedent. *Held*, there being evidence to show that the son-in-law was induced by decedent to move on the land in question under an agreement that his wife should receive the same on division of decedent's estate, that a verdict against the son-in-law should not be disturbed.—Townsend v. Boyd, (Ky.) 18 S. W. 365.

3. The owner of land, through which a public highway was opened, built a fence across the line, but placed a gate at the entrance of the road, and acknowledged that he did not cultivate the land up to the line because there was a public

road there, and for thirteen years there was travel on the highway without objection by such owner. *Held*, that a claim of adverse possession by him was not justified.—Hempstead v. Huffman, (Iowa) 51 N. W. 17.

4. Where land was given under a verbal gift, and the donees entered thereon, and held the land as their own, and adversely to the claims of the donor, for more than fifteen years, the donees acquired a perfect title.—Spradlin v. Spradlin, (Ky.) 18 S. W. 14.

5. In an action by an owner of land abutting on the west side of a street for damages from the occupation of a portion of it, east of the center line, by railroad tracks, defendant proved two deeds in due form, executed and recorded in 1873 and 1875, respectively, and purporting to convey to it the blocks on the east side of the street. Plaintiff produced three affidavits, in which each affiant swore that, in his opinion, the grantors never owned the blocks, and that defendant obtained the deeds fraudulently, for the purpose of acquiring color of title; but no fact was stated or proven in support of their opinions. *Held*, that the deeds gave defendant color of title, and that its adverse possession under them for ten years established its right to maintain its tracks against any person claiming an interest in those blocks.—Sinnot v. Chicago & N. W. Ry. Co., (Wis.) 50 N. W. 1097.

6. Possession under a tax deed is possession under color of title, sufficient to support a plea of adverse possession of lands beyond the statutory period within which an action must be brought to recover the same.—Smith v. Johnson, (Mo. Sup.) 18 S. W. 21.

7. The grantee of land conveyed under a tax-deed immediately entered thereon and enclosed it by a fence, except a gate-way, and claimed title. Shortly afterwards he sold the land. His grantee at once entered, and began to improve the land, and built a house thereon. Afterwards the land was conveyed to defendants, who have ever since resided thereon. Plaintiff contended that the evidence was insufficient to establish adverse possession, in that the gate-way was not closed, and that there was no verbal expression as to how defendants and defendants' grantor claimed to occupy the land. There was no question but that they had occupied the land more than five years. *Held* sufficient to prove all that is required by Code Civil Proc. § 322, providing that the possession of land for five years by one entering under a witten instrument purporting to convey it shall be deemed adverse, and section 323, providing that, for the purpose of constituting an adverse possession, land is deemed to have been possessed where it has been improved.—Kockemann v. Bickel (Cal.) 28 P. 686.

8. One who dedicates land to the public cannot subsequently acquire it by adverse possession.—Archer v. Salinas City, (Cal.) 28 P. 839.

9. Land dedicated to a public use cannot by adverse possession be acquired by individuals, though the title is held by a municipal corporation.—Yolo Co. v. Barney, 21 P. 833, 79 Cal. 375, followed.—Board of Education of City and County of San Francisco v. Martin, (Cal.) 28 P. 799.

10. Where land was reserved by a municipal corporation for public purposes, it cannot be divested thereof by adverse possession.—Yolo Co. v. Barney, 21 P. 833, 79 Cal. 375, and Board v. Martin, (Cal.) 28 P. 799, followed.—City and County of San Francisco v. Bradbury, (Cal.) 28 P. 803.

11. A deed to a tenant in possession from one who has no title to the land is void, and insufficient as a basis for adverse possession. 11 N. Y. S. 108, affirmed.—McRoberts v. Bergman, (N. Y. App.) 30 N. E. 261.

12. The fact that the owner of a lot had it surveyed, built a shanty upon it, and verbally gave the lot to another, and put the donee in possession, does not constitute the color of title in the donee; and, as color of title is necessary in order that adverse possession of a part of land shall draw to it constructive possession of the whole, the donee by actual adverse possession of a part only of the lot, though she claimed to own the whole, would not acquire title to the whole.—Allen v. Mansfield, (Mo. Sup.) 18 S. W. 901.

13. A quitclaim deed is sufficient color of title to support a plea of title by limitation. Parker v. Newberry, (Tex. Sup.) 18 S. W. 815.

14. A woman, finding a small island in Westchester creek, near New York city, unoccupied, entered thereon without claim or color of title, recorded or otherwise, erected buildings thereon, and remained in possession for twenty years. *Held*, that being a mere squatter, she could not obtain title by adverse possession.—In re City of New York, (Supt.) 18 N. Y. S. 82; In re Blizzard, Id.

15. Title to land is acquired by adverse possession for twenty years under a void tax-title.—Harrison v. Spencer, (Mich.) 51 N. W. 642.

16. Where the owner of an estate for life procures the issuance of a tax-deed to himself, and then conveys the land by warranty deed, possession taken thereunder is adverse to that of the remainder-man, since the warranty deed is color of title in fee.—Lewis v. Pleasants, (Ill. Sup.) 30 N. E. 323.

17. A deed from one to whom a tax-deed, regular on its face, has been issued, constitutes color of title, within the meaning of the statute of limitations, where the grantee takes

it in good faith, without knowledge of any defects, even though the tax-deed was not supported by any judgment, and the person to whom it was issued was under legal obligations to pay the taxes for which it was sold.—Lewis v. Pleasants, (Ill. Sup.) 30 N. E. 323.

18. In tresspass to try title to land lying north of what was called the southern fork of a creek, where defendant claims under a deed from plaintiff, the statute of limitations was of no avail to defendant, though it was shown that he had had possession for the requisite period, where the deed under which he claimed conveyed no land north of the southern fork. —Bassett v. Martin, (Tex. Sup.) 18 S. W. 587.

19. A creditor secured by a deed of trust purchased the land at a void sale thereunder, and the trustee made him a deed purporting to convey it in fee, and such purchaser afterwards conveyed the land in fee to another, and he and his alienee held actual possession, claiming the land in their own right, for the period of the statute of limitations. *Held* that the possession gave title, and barred the right of the grantor in the deed of trust to redeem.—Swam v. Thayer, (W. Va.) 14 S. E. 423; Same v. Young, Id. 426.

20. Whether the planting of trees upon a piece of land, and its use by cutting grass and pasturing cattle thereon during each year of the occupancy, constitutes a practically continuous, exclusive and hostile possession, such as will give title by adverse possession without color of title, is a question for the jury.—Sauers v. Giddings, (Mich.) 51 N. W. 265.

21. The word "hostile," when applied to the possession of an occupant of real estate holding adversely, is not to be constructed as showing ill will, or that he is an enemy of the person holding the legal title, but means an occupant who holds, and is in possession as owner, and therefore against all other claimants of the land. Ballard v. Hansen, (Neb.) 51 N. W. 295.

22. In order to obtain title by adverse possession without color of title, it is not necessary that the land shall be actually inclosed.—Sauers v. Giddings, (Mich.) 51 N. W. 265.

23. An actual entry upon, and possession of land though in fact tortious and without color of paper title, if under a claim of right thereto, in opposition to, and inconsistent with that of the true owner, may ripen into title by adverse possession; and continued acts of ownership upon the property, occupying, using and controlling it as owner, is an assertion of a claim of title, and sufficient notice of such claim to the owner.—Village of Glencoe v. Wadsworth, (Minn.) 51 N. W. 377.

24. In ejectment, when it appears that defendent held

possession of land for over twenty years, claiming up to a certain fence which was supposed to be on the dividing line, whereas in fact, the fence encroached several feet on plaintiff's land, defendent acquires title by adverse possession, though he admitted on the trial that he claimed to the fence because he thought it was the true line.—Battner v. Baker, (Mo. Sup.) 18 S. W. 911.

24. To affect the disseisin of the real owner of the land, the entry, under a duly registered deed from one having no title, must be followed by an open, notorious, exclusive possession, continued uninterruptedly during the statute period.—Roberts v. Richards, 24 A. 425, 84 Me. 1.

25. The essential use and occupation of land by one claiming adversely must be of such unequivocal character as will reasonably indicate to the true owner visiting the premises during the statute period that, instead of suggesting the probable invasion of a mere occasional trespasser, they unmistakably show an asserted exclusive appropriation and ownership.—Roberts v. Richards, 24 A. 425, 84 Me. 1.

26. Where plaintiff relies on possession alone, it must be actual, and not constructive; and the fact that he made one crop on the land is insufficient.—Conn v. Franklin, (Tex. Sup.) 19 S. W. 126.

27. Where coterminous owners of land establish a boundary line, and take possession to the line so agreed on, and one of them erects valuable improvements thereon, and holds quiet and peaceable possession thereof, without objection from the other coterminous owner or his grantees, for a period of more than eight years, such line is binding on them, and those holding under them.—Idaho Land Co. v. Parsons, (Idaho) 31 P. 791.

28. No one can obtain a right in a public highway by adverse use.—Wolf v. Town of Sullivan, (Ind. Sup.) 32 N. E. 1017.

29. Act May 18, 1807, provides that the first seven feet of the sidewalk space of a street in the city of Detroit shall be reserved for erecting porches in front of houses, for grass plat, and for other purposes of utility and ornament, according to the inclination of the proprietor. Act Nov. 7, 1815, provides that no erection on this space shall exceed fifty inches in height, and that every person placing a fence on the front line of the ten feet shall also place another fence on the rear line of said ten feet, along the line of his lot, and said ten feet shall not be severed from the street. *Held*, that where an owner built his house so that it stood partly on a strip claimed to be within the limits of the street, and enclosed the whole strip together with his lot, not separating it therefrom by a fence, he

was not acting within the license of such acts; and his possession of the strip was adverse to the city.—Flynn v. City of Detroit, (Mich.) 53 N. W. 815.

30. When there has been an entry upon land under color of title by deed, although the actual settlement and improvements are on only a small portion of the tract, yet, when there is nobody in possession of the rest of the tract the law presumes the entry to be co-extensive with the grant. Ellicott v. Pearl, 10 Pet. 412, followed.—Smith v. Gale, 12 S. Ct. 674.

31. A person who has actual possession of a part of a tract of land described in his deed has constructive possession of the whole.—Porter v. Miller, (Tex. Sup.) 19 S. W. 467.

32. Where there is no paper giving color of title defining the extent of adversary possession, but it is only under claim of title, the possession will be limited to inclosure, clearing, or actual improvement.—Jarret v. Stevens, (W. Va.) 15 S. E. 177.

33. The possession of a portion of a street by a railroad company entering under authority given by its charter is not adverse to the public, where there is no exclusion of the public use.—Village of Wayzata v. Great Northern Ry Co., (Minn.) 52 N. W. 913.

34. To obtain title to land by prescription of thirty years, the intention of possessing as owner as well as the possession of the land must be proven, and it is not enough to show cultivation of the land.—Clemens v. Myer, (La.) 10 So. 797.

35. In ejectment between owners of coterminous subdivisions of a lot of land in a city, plaintiff claimed under a conveyance describing his subdivision as being "about twenty-nine feet" in width. Conveyances of the other subdivisions of the lot by metes and bounds demonstrated the fact that plaintiff's lot was only twenty-seven feet in width. Plaintiff has always supposed and claimed that his lot was twenty-nine feet wide, but had never been in the occupancy of nor claimed any of the two feet beyond the true boundary. *Held* insufficient to support a claim of title to such strip of two feet by adverse possession.—Kunze v. Evans, (Mo. Sup.) 18 S. W. 36.

BOUNDARIES.

1. A fresh water stream, which at low tide flows through a tidal channel, from which the tide wholly ebbs, does not constitute "low water mark" within the meaning of the colony ordinance of 1641–47, providing that the title of owners of land adjoining tidal waters shall extend to "low-water mark," and such a channel is not a boundary to the land of the adjoining proprietors. FIELD, C. J. and KNOWLTON and LATHROP, JJ,

dissenting,—Tappan v. Boston Water Power Co., (Mass) 31 N. E. 703; Brown v. Same, Id.

2. Flats situate in a tidal river at a point in its course above the line of low tide, are to be divided among the adjoining properties, by drawing lines from the terminal of the latter on the banks at the ordinary stage of water to and at right angles with the center line of the river.—Tappan v. Boston Water-Power Co., (Mass.) 31 N. E. 703; Browne v. Same Id.

3. Plaintiff claimed under a deed describing the land conveyed as beginning at the "sea" on A's line, thence south on the said A's line to the highway; thence west on the highway ten rods to the stake; thence north to the "shore" parallel with said A's line; thence east to the first bounds mentioned. It did not appear that the grantor intended to retain the adjoining as distinct from the upland. *Held*, that the deed conveyed to plaintiff, the flats or shore, with the upland.—Snow v. Mt. Desert Island Real Estate Co., 24 A. 429, 84 Me. 14.

4. Where land bounded southerly on the sea shore, and extending one league in width on each side of a river at its mouth, was granted, together with the island of Mount Desert, and "other islands on the forepart of said two front leagues," in ascertaining the location of the "other islands" mentioned, the rule governing "flats" between adjoining owners of land situated on the seashore does not apply.—Roberts v. Richards, 24 A. 425, 84 Me. 1.

5. On a question of boundary between two surveys, (plaintiff's land and survey No. 8,) the evidence as to the location of the calls in the field notes was conflicting. The jury was instructed, that if they found that survey No. 8 was located on the ground a certain distance "west from the west line of F. county school land, as claimed by plaintiff to find for plaintiff." *Held*, that the instruction was error, as it confined the consideration to one connection called for by the field notes, in disregard of evidence of other calls.—King v. Mansfield, (Tex. Sup.) 19 S. W. 858.

6. It is not error in ascertaining the true locality of the back line of a survey fronting, with established corners, on a river, to reverse the calls of the survey, if it is found that thereby the decrepancy in the area of the survey is lessened, and the back line falls along the line of the alleged conflicting survey, which is, moreover of prior date; the recognized rule being, that the beginning corner in the certificate of survey is of no higher dignity than any other corner.—Miles v Sherwood, (Tex. Sup.) 19 S. W. 853.

7. Where, upon a town plat, the only boundary for part of a street on one side of a navigable lake, the street extends

to low-water mark.—Village of Wayzata v. Great Northern Ry. Co. (Minn) 52 N. W. 913.

8. Where there is a decrepancy between the survey of an addition to a town, as shown by the plat, and as the lines were actually run, the purchasers of lots described merely according to their numbers, take title according to the lines actually run, when they can be ascertained.—Root v. Town of Cincinnati, (Iowa,) 54 N. W. 206; Kerr v. Same, Id.

9. Where it is shown that purchasers of lots in an addition to a town, took possession and fenced their lots soon after the survey was made, and that the person who made the plat pointed out the bounds of the lots, it will be presumed that their possession was taken according to the lines of the actual survey.—Root v. Town of Cincinnati, (Iowa,) 54 N. W. 206; Kerr v. Same, Id.

10. The fact that a deed described the property conveyed as commencing at a known monument on the shore of a pond, and running thence "along said pond," does not show an intention to convey only to the shore. 11 N. Y. S. 87, reversed. —Gouverneur v. National Ice Co., (N. Y. App.) 31 N. E. 865.

11. A deed of land bordering on a small non-navigable lake or pond is presumed to convey title to the center of the lake or pond, unless the contrary appears.—Wheeler v. Spinola, 54 N. Y. 377, distinguished. 11 N. Y. S. 87, reversed.— Gouverneur v. National Ice Co., (N. Y. App.) 31 N. E. 865.

12. A deed described the land conveyed as bounded by the "northeasterly side" of W. street, "together with the free and common use, right, liberty and privilege of said * * * W. street." *Held*, where the whole of such street was on the grantor's land, that the grantee took the fee only to the side line of the street, with a right-of-way over the whole street.— Hobson v. City of Philadelphia, (Pa. Sup.) 24 A. 1048.

13. Gen. St. 1889, par. 1836, provides that, whenever landowners shall desire to establish permanently the boundaries of their lots, they shall notify the county surveyor, who shall forthwith notify all parties interested of the time of making the survey. He shall make the survey at such time, and file the evidence taken, and a plat and notes of the survey, in the office of the register of deeds, within ten days after the completion of the survey. *Held* that, where the surveyor made only a partial survey at the time named in the notice, and completed it six weeks later, without notice to a party interested, the survey did not comply with the statute; and in an action in the nature of trespass, the boundary line being at issue, the survey was not conclusive, and the exclusion of evidence as to the location of the line prior to the survey was error.—Schwab v. Stoneback, (Kan.) 31 P. 142.

14. Where the calls in a conveyance of land are for two corners, one at high water mark on the bank of a stream, and the other at the stream, and there is an intermediate line extending from one such corner to the other, the stream is the boundary, and all riparian rights pass, unless a different intention of the parties is shown by either their conduct or the conveyance.—County of St. Clair v. Lovingston, 23 Wall. 46, and Railroad Co. v. Schurmeier, 7 Wall. 272, followed. 47 F. 757, affirmed.—Whitehurst v. McDonald, (C. C. A.) 52 F. 633.

15. Where a street, as abutting on which a lot was conveyed, had been surveyed and its location designated by stakes set at the corners of the lot when the deed was made, the boundary of the street forms the boundary of the lot, though the measurements given in the deed would include a portion of the street, whether the grantee had actual knowledge of the stakes or not.—Foley v. McCarthy, (Mass.) 32 N. E. 669.

16. Courses and distances must yield to the demands of an actual survey when the evidence determines the fact of such survey; so that, where the surveyor's field notes show actual surveys on the ground, and the lines and corners thereof are called for as contiguous, and evidences of such surveys are still found which reasonably indicate an excess in the distance of the lines of 260 varas in 7,116 varas, at the date of the survey, (1856,) considered trifling, and a slight variance of seventy-five varas in the course, these discrepancies should not overcome the other evidence pointing to the fact that the surveys are contiguous.—Graham v. Dewees, (Tex. Sup.) 20 S. W. 127.

17. Where a survey is made without legal authority, copies of the field notes thereof, though certified from the general land office, are inadmissible.—Von Rosenberg v. Haynes, (Tex. Sup.) 20 S. W. 143.

18. In a dispute as to the boundary line between adjoining proprietors, testimony that a former owner of the elder survey, who was one of the original surveyors of the tract and helped to locate the corners, and who has since died, pointed out to witness a certain place as a corner, is admissible.—Beal v. Asberry, (Tex. Sup.) 20 S. W. 115.

19. The expressions, "middle of the Mississippi river" and "the center of the main channel of that river," as used respectively in the enabling acts under which the states of Illinois and Wisconsin were admitted into the Union, and "middle of the main channel of the Mississippi river," as used in the enabling acts of Missouri and Iowa, all being descriptive of the boundaries of those states, are synonymous terms, and mean the middle of the main navigable channel, or channel most used, and not the middle of the great bed of the stream, as de-

fined by the banks of the river.—State of Iowa v. State of Illinois, 13 S. Ct. 239.

20. Where the description in a deed, after following the line of another tract to a certain point, contains a clause "thence with that line to a stake on the west bank of the branch," it should be construed as intending to follow the boundaries of such tract, though the courses change before reaching the branch, and though the branch would be reached at a less distance by following an extension of the first course from the point in question.—Buckner v. Anderson, (N. C.) 16 S. E. 424.

21. The locative calls in a patent, in accordance with which the survey is admitted to have been actually made on the ground, control more general calls as to the county, and the direction and distance of the land from certain well known points.—Minor v. Kirkland, (Tex. Civ. App.) 20 S. W. 932.

22. Plaintiff claimed that, under a patent granting the "east half" of a quarter section, his land extended to a north and south line dividing the quarter section in equal halves, while defendant claimed through a patent granting the west half of the quarter, "according to the official plat of the survey," which placed the division line fifteen feet east of the line claimed by plaintiff. The quarter section was fractional, and according to the official plat the west half contained ninety acres, while the east half contained but eighty. *Held*, that as the official plat controlled the identification of lands granted by government patents, plaintiff had no title to the strip of land in dispute.—Turner v. Union Pac. Ry. Co., (Mo. Sup.) 20 S. W. 673.

23. Where, in trespass to try title, there is a conflict in the calls of a railroad survey under which plaintiff claims, parol testimony is admissible to show where the metes and bounds of the surveys were actually run and marked upon the ground.—Minor v. Kirkland, (Tex. Civ. App.) 20 S. W. 932.

24. In an action to obtain possession of land, where a controversy arises as to which one of two branches is meant by a clause in a deed which states "thence with that line to a stake on the west bank of the branch," and the evidence is conflicting as to whether there is in fact any branch crossing such line at the point claimed by plaintiff, the question as to which branch was intended was properly submitted to the jury.—Buckner v. Anderson, (N. C.) 16 S. E. 424.

25. Where a controversy arises as to which one of two branches is meant by a clause in a deed which states "thence with that line to a stake on the west bank of the branch," though there be evidence that the parties agreed by parol where the true boundary ran, after the exe-

cution of the deed, it is proper for the court to refuse to instruct the jury that by such verbal agreement the parties could alter the boundaries as fixed in the deed, and would be estopped from disputing the new location so agreed upon.—Buckner v. Anderson, (N. C.) 16 S. E. 424.

26. Under Rev. St. U. S. § 2396, which provides that the boundary lines actually run and marked in the surveys returned by the surveyor general shall be established as the proper boundary lines of the sections or subdivisions for which they are intended, a resurvey made three years after a patent is issued cannot, in the absence of fraud, change the corners and boundaries as established by the original survey so as to affect the patentee's rights.—Spawr v. Johnson. (Kan.) 31 P. 664.

27. Where objects, natural or artificial, are called for in the field notes of official surveyors, the presumption is that such objects actually existed.—Kuechler v. Wilson, (Tex. Sup.) 18 S. W. 317.

28. In a deed of conveyance, the boundary lines of the granted premises, designated by courses and distances, starting from a definite place of beginning, disclosed no error or inconsistency until the last line was reached, which was to run to the place of beginning;" but the given course and distance, would not bring it to that point, nor complete the enclosure of any land. *Held*, that the course and distance of the last line should be rejected as erroneous, and effect be given to the more certain designation, "thence to the place of beginning."—Owings v. Freeman, (Minn.) 51 N. W. 476.

29. Where a fence is built between two lots on the line indicated by the first survey, and the lots are purchased in reliance on the correctness of such line, the purchasers are entitled to maintain it as a boundary, even though a subsequent survey shows it to be wrong. Flynn v. Glenny, 17 N. W. 65, 51 Mich. 580, followed.—Le Compte v. Lueders, (Mich.) 51 N. W. 542.

30. Plaintiff's predecessor in title, through mistake as to the true boundaries of land purchased by him, built his fence so as to include other land of his grantor not conveyed by the deed. The land so inclosed was occupied and cultivated by plaintiff and his predecessor as a homestead, for more than forty years. Code Civil Proc. N. Y. § 327, provides that "for the purpose of constituting adverse possession by a person claiming title not founded on a written instrument, the land is presumed to have been possessed and occupied * * * (1) where it has been protected by a substantial enclosure; (2) where it has usually been cultivated and improved." Section 363 provides that such possession for twenty years will overcome the presumption in favor of the owner of the legal title.

Held, that plaintiff has a good title by adverse possession. 12 N. Y. S. 693, affirmed, without opinion.—Eldridge v. Kenning, (N. Y. App.) 29 N. E. 1028.

31. In trespass for cutting down timber; it appeared that the division line between plaintiff and defendant had been surveyed by courses and distances; that, commencing at the point specified, and running either as claimed by plaintiff or by defendant, some of the distances, where no monuments were specified in the description, must be disregarded in order to return to the point started from. *Held*, that this raised a latent ambiguity to solve which oral testimony was admissible. —Rugg v. Ward, (Vt.) 23 A. 726.

32. In ejectment arising out of a boundary dispute, both parties claimed to a certain old line, and both relied on adverse possession; defendants contention being that there was a jog in the old line. Plaintiff having given the evidence of adverse possession for the prescriptive period, defendent introduced evidence that he himself had been in adverse possession to an old board fence, which remained upon the ground until a few years before the trial, and that this fence was located on the line of the jog claimed by him. *Held*, that it was proper for plaintiff to show in rebuttal that this fence stood upon a straight line with the rest of the boundary.—Wineman v. Grummond, (Mich.) 51 N. W. 509.

33. In ejectment arising out of a boundary dispute, where both parties claim to a certain old line, and both rely upon adverse possession, it is competent for plaintiff to introduce the title deeds for both himself and defendant, the boundary being therein described by reference to the old line by name, since they tend to show the location of the respective lots, and that the question at issue is as to the true location of the old line named therein.—Wineman v. Grummond, (Mich.) 51 N. W. 509.

34. A grant of lands bounded by navigable tidewater carries no title to land below high-water mark.—DeLancey v. Piepgras, (Sup.) 17 N. Y. S. 681.

35. Occupants of government land caused the same to be platted as a town-site, with a street along the shore of a navigable lake. Thereafter this town-site was entered and purchased, and title thereto obtained by a judge of the district court, as provided by act of congress of May 23, 1844. In the execution of his trust, said judge conveyed to one of the beneficiaries a lot fronting upon the street before mentioned, describing the same in accordance with the town plat. *Held*, that the fee title, subject to the public easement, to the entire street to low-water mark, including all the riparian rights, and not merely to the middle of the street, passed to the

grantee, and on a conveyance by him by the same description passed to his grantee.—Wait v. May, (Minn.) 51 N. W. 471.

Where monuments mentioned in a deed are identified, they control both courses and distances given, whether they were seen by the parties to the deed or not.—Anderson v. Richardson, (Cal.) 28 P. 679.

37. Where the boundaries of a survey cannot be located by its own calls and field-notes, they may be established by the field-notes of adjacent surveys.—Kuechler v. Wilson, (Tex. Sup.) 18 S. W. 317.

38. Where a junior survey was not made on the ground, and the calls are for the surrounding surveys, the lines of such surveys will be the lines of the junior survey.—Kuechler v. Wilson, (Tex. Sup.) 18 S. W. 317.

39. The mere fact that the owner of land, desiring to break it, calls upon the owner of adjoining land to point out the boundary between them, and that the latter indicates what he supposes to be the line, does not create an estoppel against such adjoining owner to claim the true line, if different from the one pointed out.—Heinz v. Cramer, (Iowa,) 51 N. W. 173.

40. On an issue as to the true location of the western boundary line of a certain claim, the evidence showed that the line contended for by defendent was identified by the first surveyor of the claim as the line run by him, which line the government surveyor followed in his survey; that it substantially agreed with the natural calls in the field-notes of the government survey; that it was traceable by marks and blazes on the trees; that it agreed substantially with the reputed line as evidenced by certain fences; and that it intersected the south-eastern corner of the claim adjoining on the west, while the line contended for by plaintiffs ran some sixty feet further east. Plaintiffs' contention was supported only by the fact that what they claimed to be the south-western corner was the north-western corner of the claim adjoining on the south, which corner was intended to be identical with the southern terminus of the line in dispute, and which was within six feet of the correct distance from the south-eastern corner of the claim on the north according to the field-notes. But the claim on the south was located subsequently to the government survey before mentioned. *Held*, that the evidence showed defendants' contention to be the true line.—Van Dusen v. Shively, (Or.) 29 P. 76.

41. In an action of trespass for cutting timber, where the location of the dividing line between the parties is relevant, the testimony of the county surveyor that he ran the line pending the suit, that defendant was present when this was done, and that a certain map of the survey is correct, is admissible evidence for plaintiff, notwithstanding the surveyor also testifies

that the work was done in the course of processioning the land in accordance with the statute on that subject.—Gunn v. Harris, (Ga.) 14 S. E. 593.

42. In ejectment arising out of a boundary dispute, where both parties claim to a certain old line, and both rely upon adverse possession, the defendant's contention being that there was a jog in this old line, it was competent for an experienced surveyor, familiar with the property, to testify that he had surveyed the line some time in the 50's and found it to correspond with certain maps then in existence, and then to testify by the aid of those maps that the line was straight, instead of containing a jog, although such maps were not shown to be authentic.—Wineman v. Grummond. (Mich.) 5 N. W. 509.

43. Where the description in a deed is by metes and bounds, which are complete in themselves, and which are so made as to exclude a certain road, a reference to the road for the purpose of designating the point from which the description starts and the course of a line therefrom does not show an intention to make the road the boundary of the land, except as it coincides with the description in the deed; and the grantee, therefore, is not entitled upon the discontinuance of the road as a public way, to claim an easement therein, as appurtenant to the premises against the grantor.—Lankin v. Terwilliger, (Or.) 29 P. 268.

44. Where there is a conflict as to the location of land by a survey, but two corners thereof can be definitely identified, the courses and distances may be ascertained from the field-notes, and the entire survey constructed therefrom; and in such case the distance and quantity must yield to course.—Rand v. Cartwright, (Tex. Sup.) 18 S. W. 794.

45. A monument established by the government surveyors as the true corner of sections will control courses and distances.—Brown v. Morrill, (Mich.) 51 N. W. 700.

46. Where, in an action to recover possession of land, the evidence is conflicting as to the true location of a station, which is described as a natural monument, and is located in a different place by the courses and distances, the natural monument will control.—Stoll v. Beecher, (Cal.) 29 P. 327.

47. Where the public have only a right of way over a public street, a conveyance of the abutting land, describing it as "bounded by" such street, includes the land to the center of the street.—Firmstone v. Spaeter, (Pa. Sup.) 25 A. 41; In re Kimber's Estate, Id.

48. Where, in a suit by certain property holders against a city, the evidence shows an uncertainty as to the direction in which one of the boundary lines of the city should run, but it appears that the boundary claimed by the city has been acqui-

esced in by both parties for over twenty years, and until the time of bringing the suit, such boundary will be considered the correct one.—Belknap v. City of Louisville, (Ky.) 20 S. W. 309.

49. A mere parol agreement of adjoining land-owners as to the boundaries between them, which changes the legal construction of the title deed, is not binding on subsequent purchasers.—Shaffer v. Hahn, (N. C.) 15 S. E. 1033.

50. Where the owners of land convey the same, bounding it by the line of a highway, parol evidence is admissible to show whether, by such description, the parties meant the surveyed line of the highway, or the line as actually used and occupied.—Wead v. St. Johnsbury & L. C. R. Co., (Vt.) 24 A. 361.

51. Where, in a suit to establish a section corner, the only objections to the commissioner's report are as to his findings, the court may, after sustaining the objections, establish the corner without again referring the case to the commissioner,—Yocum v. Haskins, 46 N. W. 1065, 81, Iowa, 437, distinguished. Doolittle v. Bailey, (Iowa,) 52 N. W. 337.

52. Where, in a suit to establish a section corner, the evidence shows that it was located at a certain point, the court should establish the corner at that point, even though such point is not equidistant from the section corners on either side of it.—Doolittle v. Bailey, (Iowa,) 52 N. W. 337.

53. The word "adjoining," in the description of premises conveyed, means "next to," or "in contact with," and excludes the idea of any intervening space. The description of the premises granted as "adjoining the Atlantic ocean," with the additional words "bounded on the ocean," carries title to the line of ordinary high water, with all the incidents of riparian ownership upon tidal waters.—Yard v. Ocean Beach Ass'n, (N. J. Err. & App.) 24 A. 729.

54. In establishing section lines, corners shown to have been originally made by government surveyors are conclusive, and shall be accepted as the true corners, no matter how inaccurately they may have been originally established.—Town of Liberty v. Burns, (Mo. Sup.) 19 S. W. 1107.

55. Where the monuments, or objects, or marks called for in a deed have been obliterated, their former site or location must be established with reasonable certainty, in order that they shall prevail over the lines established by explicitly given courses and distances, or to throw an evident error of description by courses and distances into the second boundary line as given, which otherwise would be charged to the fourth or last line, and correct the description by rejecting the given courses and distances, and bringing the last line to the terminus defi-

nitely described in the conveyance as "the point of beginning." Yanish v. Tarbox, (Minn.) 15 N. W. 1051.

56. Where there is a variance between the plat and the field-notes of the original survey of public lands, the former must control, since it represents the lines and corners as affixed by the surveyor general, and by which the land was sold.—Beaty v. Robertson, (Ind. Sup.) 30 N. E. 705.

57. In a proceeding to establish section corners it is not a misjoinder of parties plaintiff, or of causes of action to join as plaintiffs owners within the section interested in the south-west corner only, with owners interested in the north-west corner only.—Rollins v. Davidson, (Iowa,) 50 N. W. 1061.

58. In a proceeding to establish section corners it is proper to exclude evidence "tending to show that there were decrepancies between the known monuments and field-notes of surveys of other townships in the county made by the same government surveyor."—Rollins v. Davidson, (Iowa,) 50 N. .W 1061.

59. Where a creek, in a time of freshet, breaks through a narrow neck of land, and afterwards continues to flow through the new channel, separating the neck from the tract to which it originally belonged, such separation is not caused by the "wear of the creek," within the meaning of a deed which conveyed to plaintiff the tract of which such neck was a part, "less the wear of a creek."—Henning v. Bennett, (Sup.) 18 N. Y. S. 645.

60. A deed described the boundary of the land conveyed as beginning at a fixed point, and running a certain course a distance of "about" 865 feet, to a "point on" the shore of Long Island Sound; thence running "along the shore and Sound" to a certain point; and thence, by a given course, a distance of "about" 1,288 feet to the place of beginning; containing a certain number of acres "more or less." To make the distances and acreage agree with the deed, the courses would have to be run to low-water mark, and along low-water mark. *Held*, that the deed conveyed the land to low-water mark, and included the shore, notwithstanding the rule that by the shore as a monument is meant the line of high water, when the boundary is the sea.—Oakes v. DeLancy, (N. Y. App.) 30 N. E. 974.—Oakes v. Delancy, (Super. N. Y.) 15 N. Y. S. 561 affirmed.

61. The United States sold the North half of a government section to plaintiff's predecessors, and set off to the state the south half for schools, by reference to the survey and plat returned by the surveyor general. *Held*, in an action against the state's grantee, that the location of the dividing line between the north and south half must be determined from such plat and the acts of congress relating to the survey of the

public domain.—Goltermann v. Schiermeyer, (Mo. Sup.) 19 S. W. 484.

62. Rev. St. U. S. § 2395, provides that, where townships which are subdivided "exceed, or do not extend six miles, the excess or deficiency shall be specially noted, and added to, or deducted from the western and northern ranges of sections or half sections," and these irregular sections and half sections "shall be sold as containing only the quantity expressed in the returns and plats," and all others as containing the legal quantity. Section 2396 provides that "all the corners marked in the surveys returned by the surveyor general shall be established as the proper corners of sections or subdivisions of sections they were intended to designate; and the corners of half and quarter sections, not marked on the surveys, shall be placed, as nearly as possible, equidistant from two corners which stand on the same line." *Held*, the law making it the surveyor general's duty to calculate the areas, and state the result thereof on the plat, that it is competent for him to note thereon, as part of the plat, the distances of quarter section lines on which such calculations were based.—Goltermann v. Schiermeyer, (Mo. Sup.) 19 S. W. 484.

63. Even if the figures designating the distances on which such calculations were based should have been omitted from the plat, still, where a quarter section corner was fixed up by the surveyor general by stating the distance thereof from the section corner, and the government accepted the plat and sold the land in pursuance thereto, such acceptance through the political departments adopted the plat with all the marks and figures thereon, and is not reviewable by the courts.—Goltermann v. Schiermeyer, (Mo. Sup.) 19 S. W. 484,

64. Even if the figures designating the distances on which such calculations were based should have been omitted from the plat, a township is not made "fractional," because in laying it off into sections, there is a deficiency or excess to be carried into the western or northern range of half and quarter sections. —Goltermann v. Schiermeyer, (Mo. Sup.) 19 S. W. 484.

65. Where a section is divided by a water course, and is subdivided in lots instead of regular subdivisions, and a lot bounds on the water course, the water course itself, and not the meander lines thereof, is the proper boundary; and, if the grantee does not find the water course as called for by his patent, he may go as far as the next "eighth line" to locate his boundary.—Lally v. Rossman, [Wis.] 15 N. W. 1132.

66 Where the description in a deed contains no patent ambiguity, but, on its application to the land described, it results in a lot of the most singular shape, plainly never intended by the parties, there is no error in ignoring the calls for

courses, and applying only the calls for distance, where the land which the evidence shows was intended to be conveyed may be thereby fully identified.—Toklin v. Anderson, (Tex. Sup.) 19 S. W. 350.

67. In a suit to establish a section corner the evidence showed that all the owners of adjoining land, except plaintiff, had openly acquiesced in a certain location for the corner for more than ten years; that plaintiff had owned his land for eight years, during which time he had acquiesced in said location; that his grantor was a non-resident; and that plaintiff, when he fenced the land, built his fence according to said location of the corner. *Held*, that the evidence justified a finding that plaintiff and his grantor had acquiesced in said location of the corner for ten years.—Doolittle v. Bailey, (Iowa,) 52 N. W. 337.

68. Code Civil Proc. § 368, provides that "in an action to recover real property, * * * the person who establishes a legal title to the premises is presumed to have been possessed thereof within the time required by law, and the occupation of the premises by another person is deemed to have been under and in subordination to the legal title, unless the premises have been held and possessed adversely to the legal title for twenty years before the commencement of the action." *Held*, that in ejectment to establish a disputed boundary, where the defense is acquiescence in the line claimed by defendent, he must show such acquiescence for at least twenty years.—Clark v. Davis, (Super. N. Y.) 19 N. Y. S. 191. 28 Abb. N. C. 135.

69. In ejectment, where the quarter section of land which included the disputed territory contained sixty-seven acres more than the required number, and no subdivisional survey of such quarter section was made until 1883, when the corners were established by the county surveyor at the instance of defendant, his failure for three years to appeal from such survey made it conclusive evidence of the true location of the dividing line.—Sin v. King, (Ind. Sup.) 31 N. E. 48.

DEDICATION.

1. Where a land-owner files a map of a number of blocks owned by him, on which one block is marked "Central Park," circulates copies of the map, and states in an advertisement, and announces through an auctioneer, while selling the adjacent blocks, that such a block is reserved for a park he dedicates the park to the public.—Archer v. Salinas City, (Cal.) 28 P. 839.

2. Where a land-owner files a map of a number of blocks owned by him, on which one block is marked "Central Park," circulates copies of the map, and states in advertisement, and

announces through an auctioneer, while selling the adjacent blocks, that such a block is reserved for a park, actual acceptance is not requisite to complete the dedication, since acceptance will be presumed from the benefit arising from the dedication. People v. Reed, 22 P. 474, 81 Cal. 70, distinguished.—Archer v. Salinas City, (Cal.) 28 P. 839.

3. Where a land owner files a map of a number of blocks owned by him, on which one block is marked "Central Park," circulates copies of the map, and states in an advertisement, and announces through an auctioneer, while selling the adjacent blocks, that such a block is re-reserved for a park, failure of the public to use the dedicated land for the purpose intended does not impair the dedication, nor authorize the prior owner to resume possession.—Archer v. Salinas City, (Cal.) 28 P. 839.

4. Marking a street on the plat of a town or addition thereto, and selling lots with reference to such street, dedicates the ground so marked to the use of the public as a street, and purchasers of lots have a right to have all streets marked on the plat by which they purchased kept open.—Wolfe v. Town of Sullivan, (Ind. Sup.) 32 N. E. 1017.

5. Mary Washington was interred in a burial lot, with the consent and approval of the owner, and forty-two years thereafter a monument was erected over her grave by an association organized for that purpose. The corner stone was laid, with civic ceremonies and military pageant, by the president of the United States. *Held*, that there was a complete dedication of the tomb to public and pious uses.—Colbert v. Shepherd, (Va.) 16 S. E. 246.

6. Where the owner of a tract of land lays it out in lots and streets, and in the plan or map thereof filed with the public records designates a certain portion as "Park," and afterwards conveys lots and blocks by reference to such plan, it operates as a dedication of the land for a public park, and his successor in interest cannot, after the lapse of more than twenty years, set up as against the public a different intent.—Steel v. City of Portland, (Or.) 31 P. 479.

7. Where land outside of a city is platted as a town site, and by consent of the owners a railroad is built on a strip marked on the plat as a street, but which has never been accepted by the public as such, neither the subsequent annexation of the land to the city nor the acceptance of the strip by the authorities thereof renders the occupation by the railroad a nuisance, subject to abatement by resolution of the city council.—City of Denver v. Denver & S. F. Ry. Co., (Colo. Sup.) 31 P. 338.

8. Where one plats a townsite, and leaves a strip 100 feet

wide running through the town, which he designates on the town plat as "M. Street," and he and his grantee permit the public to use such strip as a street for ten years or more, he is estopped from denying that the entire 100 feet was dedicated, regardless of a general statement on the plat that all the streets are sixty-six feet wide.—Smith v. Montgomery, (Idaho,) 31 P. 812.

9. Where a proprietor of land lays it out in lots, which he afterwards conveys according to a plat which shows the lots are upon a street, the conveyance of the lots bounded on the street is a dedication of the land covered by the plotted street to the use of the lot owners as a means of access to their lots, and he can retain no title to such street, as against the lot owners, except by express reservation in his deed.—Dobson v. Hohenadel, (Pa. Sup.) 23 A. 1128.

10. When the owner subdivides property into city blocks, streets and alleys, marking the streets and alleys on the ground, and files the plat, and in selling and making deeds of lots describes them with reference to streets and alleys as platted, the intention to dedicate the streets and alleys is manifest, and the owner retains no interest in the same, though the plat was not acknowledged as required by statute.—Heitz v. City of St. Louis, (Mo. Sup.) 19 S. W. 735.

11. Acceptance and user by a city of a street or a portion of a street as platted is equivalent to acceptance of the whole tract platted. Heitz v. City of St. Louis, (Mo. Sup.) 19 S. W. 735.

DEED.

1. Where the courses and distances given in a deed conveying a lot show it to contain 9,101 square feet, instead of only 7,770, as stated in the deed, evidence that the grantee of an adjoining lot, claiming under the same grantors, built a fence on the line, as he supposed it to be, between his lot and the one in question, is not admissible to control the description of the line in the first deed.—Hall v. Eaton, 29 N. E. 660, 139 Mass. 217.

2. Where the courses and distances given in a deed conveying a lot show it to contain 9,101 square feet, instead of only 7,770, as stated in the deed, evidence that the grantors had made a plat of the land, and that this plat showed the lot to contain 7,770 square feet, is inadmissible to control the deed, when the deed does not refer to the plat, and it does not appear that the plat was shown to the grantee.—Hall v. Eaton, 29 N. E. 660, 139 Mass. 217.

3. Where the courses and distances given in a deed conveying a lot show it to contain 9,101 square feet instead of only

7,770, as stated in the deed, evidence that the grantors deeded other lots adjoining the one first granted, with descriptions showing that the first lot was intended to contain only 7,770 square feet, is inadmissible.—Hall v. Eaton. 29 N. E. 660, 139 Mass. 217.

4. For the purpose of identifying and locating artificial monuments in a deed to plaintiff, the court admitted in evidence a written contract to convey, made by a former owner of the land in dispute, together with parol testimony showing that in pursuance of the contract, the monuments in question were located by a surveyor, and that the descriptions in the deed to plaintiff's predecessor were made from the report of the surveyor. Evidence was also admitted, by one of the surveying party, as to the location of the monuments. *Held*, that all this evidence was competent.—Anderson v. Richardson, (Cal.) 28 P. 679.

5. How a deed should be construed, with a reference to a proper location of it, or what was the proper location of a particular deed, having reference to other deeds in the case, is a question of law, for the court; and it is not competent for a surveyor to give an opinion concerning such a question.—Kelso v. Steiger, (Md.) 24 A. 18.

6. The east line of a highway, as actually used and occupied, extended further east than the line as surveyed. Adjoining lands were conveyed with reference to the former line. *Held*, that the grantees as against the grantors acquired, no title to the lands lying between such lines, and on a taking of the same for a railroad right of way, the grantors are entitled to compensation.—Wead v. St. Johnsbury & L. C. R. Co., (Vt.) 24 A. 361.

7. The words "one acre, being the south-east corner of the north-east quarter," etc., contained in a sheriff's deed, without further descriptive words, are sufficiently certain, and mean an acre in a square form in the corner.—Smith v. Nelson, (Mo. Sup.) 19 S. W. 734.

8. In a deed of the "east half" of a fractional quarter section, the words "east half" refer to the government subdivision of a quarter section, and not to a subdivision of the quarter section by a line dividing it into two equal parts.—Turner v. Union Pac. Ry. Co., (Mo. Sup.) 20 S. W. 673.

9. A description in a deed, "west part N. E. quarter, N. W. quarter twenty acres," of a certain section, is sufficiently definite, the words "twenty acres" showing the words "west part" to mean "west half."—Soukup v. Union Inv. Co., (Iowa) 51. N. W. 167.

10. A deed purporting to convey a piece of land one acre square, beginning at a specified corner of an eleven-acre tract

described in a deed from P. to O., recorded on a specified page of a specified public record, to agree with the metes and bounds made by one C., sufficiently identifies the land.—Overand v. Nenczer, (Tex. Sup.) 18 S. W. 301.

11. The owner of a farm of 300 acres, in which was a garden 100 feet square, immediately behind his house, granted a railroad company a right of way across his farm, "provided the road runs at back of garden." This clause was inserted in the deed because the grantor was dissatisfied with a preliminary survey which had made the line of the road run through the garden. *Held*, that the deed gave the company no right to construct its road through the garden.—Knoxville, C. G. & L. R. Co. v. Beeler. (Tenn.) 18 S. W. 391.

12. Where a deed describes the tract conveyed as bounded, north fifty-six feet by a certain street, "east two hundred feet by other land of said grantors on a passage-way," south fifty-six feet by certain land, and west two hundred feet by another street, but it appears that no passage-way in fact exists, the deed is to be construed as conveying a tract fifty-six feet wide, irrespective of the passage-way mentioned.—Treat v. Joslyn, 29 N. E. 653, 139 Mass. 94.

13. In an action to establish a disputed boundary line, it appeared that the person from whom plaintiff derived title, settled on the public domain with the intention of acquiring three hundred and twenty acres thereof. He finally received a certificate therefor, in which the land was described only by courses and distances from an initial point, and as so described contained 322.89 acres. On this certificate a patent was issued. In neither patent nor certificate were any monuments referred to, except the initial point. The east line of this tract corresponded with the west line of defendant's land, which line was recognized for many years as the true division line by the owners on either side, until a survey was made, in which were found what are claimed to be the original stakes set by certain government surveyors, which would carry the division line 3.88 chains east, and give plaintiff twenty-seven more acres than are called for by the government patent. The courses and distances given in the field-notes of this government survey corresponded with those given in the patent. *Held*, that the boundary line was as fixed by the certificate and patent.—Hale v. Cottle, (Or.) 28 P. 901.

14. Where a deed describes the lot conveyed as bounded by certain lines, beginning at a corner on a certain street, "thence northerly * * * 134 feet; * * * thence westerly * * * 60 feet; thence southerly, * * * at right angles" to the street of beginning, 125 feet; thence easterly on said street, 61 feet, more or less, to the first mentioned bound,

containing 7,770 feet, more or less,"—the third line must be drawn at right angles to the street mentioned, though this will make the fourth line 80.52 feet long, instead of 60.5 feet, and the whole lot will contain 9,101 square feet, instead of 7,770.—Hall v. Eaton, 29 N. E. 660, 139 Mass. 217.

15. A deed of unimproved land "estimated" as 200 acres, described the boundaries as "beginning at two birches on Simmons creek, corner to A's land; and running thence up said creek with M's line, S., 55° W., 120 poles, to six chestnuts, corner to M's survey; and with the same S., 35° E., 310 poles, to a double and single poplar, corner to A.; and with the same N. 40° E., 250 poles to the beginning." *Held*, it being apparent that in running the lines in the reverse direction all the calls would be satisfied, and the ambiguity would disappear, such course should be adopted, especially as such boundaries were natural, rather than a construction which would entirely ignore Simmons creek," "Miller's line," the course "S. 55° W." and the distance "120 poles," notwithstanding that the lines so run in the reverse direction would include 375 acres.—Simmons creek Coal Co. v. Doran 12 S. Ct. 239.

16. In a written obligation to convey certain real estate, it was described as N. ½ of S. E. ¼, of section 3, in a given township and range, "less twenty-five acres off the south side." *Held*, that *prima facie* the description manifested the intention to lay off twenty-five acres in a parallelogram, with the whole of the south line of the N. ½ of the quarter section in question as its base.—Watson v. Crutcher, (Ark.) 19 S. W. 98.

17. Certain lots conveyed were described by numbers according to the grantor's plat, and also as one piece of land, bounded by "the Philadelphia & Norriston Railroad," which appeared on the city plan of streets as a plotted street 120 feet wide, in the center of which was a railroad right of way 66 feet wide, with a strip 27 feet wide on each side thereof, intended by the city as a public street. The grantor, in making his plat, adopted the line of this street, and many of his lots including those conveyed fronted thereon. *Held*, that the grantee's title, as against the grantor, extended to the middle of the street, subject to the existing rights of the railroad, the city, and the owners of lots in the grantor's plat.—Dobson v. Hohenadel, (Pa. Sup.) 23 A. 1128.

18. The fee of the streets of the city of Richmond is in the abutting owners, subject to the lawful use of the streets by the city. Telegraph Co. v. Williams, 11 S. E. 106, 86 Va. 700, and Hodges v. Railroad Co., (Va.) 14 S. E. 380, followed.—Page v. Belvin, (Va.) 14 S. E. 843.

19. A deed is sufficient which describes the land as being on a particular stream in a designated parish, adjoining certain

named properties, or upon the stream upon which it is situated within the parish designated, with the number of acres it contains, referring to the conveyance by which the vendor acquired it; errors in the description by legal subdivisions being cured by other descriptive designations, which leave no doubt of the particular tract that was intended to be sold.—Bryan v. Wisner, (La.) So. 290.

20. A deed described the land conveyed as beginning at a certain rock, and running thence one mile east, one mile north, one mile west, and one mile south to place of beginning, and also stated that it was the land set off to a certain Indian under a treaty with the government. The Indian had previously selected his land as "a tract one mile square, the exact boundaries of which may be defined when the surveys are made." After the deed was given, the Indian's land was located and patented so as to include four distinct but adjacent parcels, no part of which lay within the boundaries named in the deed. *Held*, that the deed was not a float, but attached to the described lands, and in the absence of mistake could not be construed to pass title to any of the patented lands.—Duluth Storage and Forwarding Co. v. Prentice, (Cir. Ct.) 50 F. 878.

21 Act Cong. 1848, establishing the territorial government of Oregon, and providing (sections 1—6) that to every white male citizen of the United States, emigrating to, and settling in said territory between certain dates, are granted, if single, 160 acres of land, if he shall reside on and cultivate said land for the space of four years, is a grant, and, when the grantee has qualified himself by a four-years residence and cultivation to receive the title, it immediately vests in him, though he has made no final proof, such proof being simply evidence that the grantee is entitled to a patent.—Roeder v. Fouts, (Wash.) 31 P. 432.

22. Defendants' grantor bought a tract of land described as beginning 10 chains south of the N. E. corner of a certain quarter section, running thence south 5 chains and west 10 chains so as to include 5 acres. He then platted into lots 30 feet wide, the N. ½ of the S. E. ¼ of the N. E. ¼ of said quarter section. As the quarter section contained more than 160 acres, the north line of the platted land was three feet south of the deeded land. *Held*, that a purchaser of one of the northern tier of lots, whose deed simply called for the lot by number, and who had actual notice that there was a three-foot strip north of his lot, and who had possession of 30 feet without said strip, took no title to said three-foot strip.—Mendel v. Whiting, (Ill. Sup.) 31 N. E. 431.

23. In an action by the grantee in a deed running "to a point" in Long Island Sound, to recover for a deficiency in

the acerage of the land conveyed, on the ground that the deed could only convey to the high-water line of the shore, it will not be presumed, in the face of the description in the deed definitely calling for the low-water line as the boundary, that the grantor had no title to the shore, since the common-law rule that the title to the shore is in the state does not exclude the possibility of title in the grantor derived from the state or by prescription.—Oakes v. De Lancey, (Sup. N. Y.) 15 N. Y. S. 561, affirmed.—Oakes v. DeLancey, (N. Y. App.) 30 N. E. 974.

DRAINAGE.

1. Where the court acquired jurisdiction over the subject matter by the filing of the petition, and jurisdiction over the person of the land owners by giving the statutory notice, the fact that ten days did not intervene between the time the proceedings were docketed and the time at which the court referred the petition to the drainage commissioner, will not render such proceedings void.—McBride v. State, (Ind. Sup.) 30 N. E. 699.

2. The fact that the surface of the land at the mouth of a sewer is lower than at its beginning does not prove that the sewer carries the water according to its natural drainage, where it appears that the land between the two points is so elevated that the sewer had to be sunk nine feet in order to secure a proper fall.—Dierks v. Commissioners of highways Tp. Addison, (Ill. Sup.) 31 N. E. 496.

3. Laws 1883, p. 139, §8, which authorizes commissioners of highways to enter upon land adjacent to any highway, for the purpose of opening drains or ditches to carry off the water from the highway, or drain any slough or pond on such highway, does not authorize them to enter land adjacent to a highway for the purpose of carrying over such land the sewage deposited on such highways by the drains of an incorporated village.—Dierks v. Commissioners of Highways Tp. Addison, (Ill. Sup.) 31 N. E. 496.

4. The circuit court has jurisdiction of the construction of drains, and objections to its assumption thereof in a specific case must be made directly by appeal, and a party cannot, after judgment, make collateral objection to its authority to direct the construction of a particular drain, which it has assumed, by holding the petition sufficient to give the jurisdiction.—Perkins v. Haywood, (Ind. App.) 31 N. E. 670.

5. Pub. Acts 1885, c. 227, subc. 3, § 12, provides that in case a jury, impaneled to ascertain the compensation to be made for land taken for a public drain, shall decide such drain to be unnecessary, they shall so state in their return, and the drain commissioner shall thereupon dismiss the proceedings,

and no further application for the same object shall be entertained within one year thereafter. *Held*, that the statute does not apply where the jury are discharged by reason of their failure to agree, and in such case a new jury may be impaneled without waiting a year.—Morse, C. J., dissenting. Kress v. Jackson Probate Judge, (Mich.) 52 N. W. 728.

6. Elliot, Supp. § 1193, empowering a county surveyor to levy assessments to keep public ditches in "repair," does not empower him to construct new ditches.—Romack v. Hobbs, (Ind. Sup.) 32 N. E. 307.

7. The question as to what is the most available route for the location of a ditch is one for the judgment of the drainage commissioners, and their action in making such location is not subject to review on appeal, in the absence of fraud.—Chandler v. Beall, (Ind. Sup.) 32 N. E. 597.

8. Where surface water habitually flows off over a fixed and determininate course, having reasonable limits as to width, so as to be uniformly discharged at a definite point, though without having worn out a channel having definite and well-marked banks, the line of flow is a water course, within the meaning of Rev. St. 1891, c. 42, § 78, which declares that owners of land may drain the same "into any natural water course."—Lambert v. Alcorn, (Ill. Sup.) 33 N. E. 53.

9. Substituting an underground tile drain for natural surface drainage over the same land is not an abandonment of the natural water course.—Lambert v. Alcorn, (Ill. Sup.) 33 N. E. 53.

10. The owner of land adjoining a highway has no right to drain his land into a ditch in such highway by means of a drain which carries the water in a different direction from its natural flow.—Davis v. Commissioners of Highways, (Ill. Sup.) 33 N. E. 58.

11. Rev. St. 1891, c. 42, §117, declares that owners of land outside a drainage district, who connect their ditches with those of the district, shall be deemed to have applied to be included in the district. *Held*, that the owners of such lands having, by connecting with the district ditches, voluntarily consented to the inclusion of their land in the district, are not entitled to notice of the order of the commissioners' changing the boundaries of the district so as include their lands. Commissioners v. Griffin, 25 N. E. 995, 134 Ill. 330, distinguished.—People v. Dornblazer, (Ill. Sup.) 32 N. E. 688.

12. Rev. St. 1891, c. 42, § 117, declares that owners of land outside a drainage district, who connect their ditches with those of the district, shall be deemed to have applied to be included in the district, and that their lands benefitted thereby shall be treated, classified, and taxed as other lands in the dis-

trict. *Held*, that the fact that a drainage district lies wholly within one township, and the highway commissioners are ex officio the drainage commissioners, does not prevent them from taxing for drainage purposes land in another township, which has been by its owners connected with the drains of said district, since in levying such taxes the commissioners act as officers, not of the township, but of the drainage district.—People v. Dornblazer, (Ill. Sup.) 32 N. E. 688.

13. A ditch was opened on plaintiff's land in 1882 by the order of the supervisor. The statutes provided for an assessment of damages in such cases, to be made by three electors appointed by the supervisors, and from their award there was no appeal. Laws 1885, c. 46, amended the statute by allowing an appeal to the circuit court. Subsequent to the amendment appraisers were appointed, who found that plaintiffs were not damaged by opening the ditch. *Held*, that plaintiffs were entitled to appeal from the award, since the act of 1885 was remedial, and did not interfere with vested rights.—Smeaton v. Austin, (Wis.) 51 N. W. 1090.

14. Where a railroad company constructs a ditch along its right of way, whereby it diverts surface water from the direction in which it naturally flows, and overflows land on the natural water course into which the water so diverted is finally emptied, the company is liable for the damage, though the ditch was necessary to the operation of the road and it was carefully constructed. Jenkins v. Railroad Co., 15 S. E. 193, 110 N. C. 438, followed.—Staton v. Norfolk & C. R. Co., (N. C.) 16 S. E. 181.

15. The question of the practicability of a route to be selected for a public ditch is in the discretion of the inferior tribunal or its officers, and cannot be reviewed on appeal.—Sample v. Carroll. (Ind. Sup.) 32 N. E. 220.

16. The selection of the line of a former ditch is not an abuse of such discretion.—Sample v. Carrol, (Ind. Sup.) 32 N. E. 220.

17. Since drains constructed under Act March 9, 1875, were not especially constructed under the supervision of the commissioners charged with their establishment, the county surveyor was not obliged to wait until such drains were entirely completed before having them repaired, as commanded by Elliott's Supp. 1889, § 1193, but might take possession, for that purpose, of the completed portions.—Artman v. Wynkoop, (Ind. Sup.) 31 N. E. 468.

18. Where a county commissioner, in determining the necessity for taking certain land for a drain, neglects to specify the size and location of the drain, as required by statute, or in case a jury is demanded, to issue a *venire* describing the

land, the proceedings are so defective that no legal drain can be laid, and a township supervisor, therefore, may lawfully refuse to assess a tax.—Nugent v. Erb, (Mich.) 51 N. W. 282.

19. Where a drain commissioner made his apportionment of benefits for a drain, and assessed twenty-seven per cent. of the cost on three forties of land as belonging to T., and thereafter, on learning that J. owned one of the forties, made out his assessment roll for the supervisors, dividing such cost in proportion to the acreage, and placing one-third of the amount on J.'s forty, it was an irregularity which justified the supervisors in refusing to spread the tax on such forty. —Tinsman v. Board of Supervisors, Monroe County, (Mich.) 51, N. W. 460.

20. The fact that a land-owner appeared before the commissioners appointed to assess damages and benefits for a drain, and accepted the award of damages to part of his lands, and entered into a contract to construct the drain through such lands, did not estop him from objecting to an irregularity in assessing another parcel, where he had no knowledge that such other parcel had been assessed until the assessment roll was completed, at which time it was too late to appeal from the act of the commissioners.—Tinsman v. Board Supervisors, Monroe County, (Mich.) 51 N. W. 460.

21. Though laws of Indiana provide that ditch assessments shall be made by the county surveyor, and appeals therefrom prosecuted against him, the county only is financially interested in the collection of the assessment, and is entitled to defend in the name of the county surveyor, or to employ attorneys to appear for the county surveyor and resist the appeal.—Stingley v. Nichols, Shepherd & Co., (Ind. Sup.) 30 N. E. 34.

22. A county surveyor cleaned out a public ditch and its arm, and warrants were drawn on the county treasurer to pay therefor. An assessment was afterwards made on the land-owners along the ditch to reimburse the county, from which assessment they appealed. The appeal-bonds were made payable to the county surveyor, instead of the deputy-surveyor, who made the assessment. The lands assessed were not described therein, nor was it stated whether the repairs were to the main ditch or its arm. *Held* immaterial.—Stingley v. Nichols, Shepherd & Co., (Ind. Sup.) 30 N. E. 34.

23. Upon proceedings to assess benefits of a proposed extension of a ditch, the fact that certain lands in the drainage district are sufficiently drained by the ditch without an extension is no objection to assessing such lands on account of the extension.—Briggs v. Union Drainage District, (Ill. Sup.) 29 N. E. 721.

24. Land not assessed for the construction of a ditch cannot be assessed for repairs, under the express provisions of Elliott Supp. § 1193.—Scott v. Stingley, (Ind. Sup.) 31 N. E. 953.

25. On appeal to the circuit court from assessments levied by the county surveyor for the repair of a ditch, appellants cannot escape liability on the ground that no additional assessments had been levied against other land-owners, who had permitted the cattle to obstruct the ditch, where appellants made no effort to prove the additional cost of removing such obstruction so as to enable the court to adjust the assessments.—Scott v. Stingley, (Ind. Sup.) 31 N. E. 953.

Under Elliott Supp. §1193, which requires the county surveyor to keep the ditches in his county in repair, the surveyor is the judge of the means to be employed to accomplish the work, and land-owners cannot escape liability on assessments because the workmen employed were paid by the day, and no competition was invited.—Scott v. Stingley, (Ind. Sup.) 31 N. E. 953.

27. The fact that a county surveyor, in repairing a ditch, exceeded the jurisdiction conferred on him by Elliott, Supp. § 1193, in that he widened the bottom of the ditch beyond the original specifications, does not relieve the land-owners from paying for benefits received by the performance of such work as was within the jurisdiction of the surveyor; and where the assessments levied are short of the amount actually paid by the county for the repairs, the supreme court on appeal will presume, in the absence of evidence to the contrary, and in favor of the findings of the lower court sustaining the assessments, that appellants' lands were not assessed in an amount greater than their just proportion of legitimate costs of repairing the ditch.—Scott v. Stingley, (Ind. Sup.) 31 N. E. 953.

HIGHWAYS.

1. Where it is necessary for a commissioner of highways, in the discharge of his public duty, to shut off the water from a mill in order to repair a culvert forming part of an artificial water course or tailrace, passing under a public street, and the repairs are prosecuted with diligence and reasonable care, the commissioner is not liable for damages for the loss of power to the mill pending such repairs.—Kerr v. Joslin, (Sup.) 20 N. Y. S. 929.

2. A highway which, after having been opened and used beyond the memory of any living man, is found not to conform precisely to the original survey, can only be changed by proceedings under the road laws; and until such proceedings are had the abutting owners cannot be compelled to conform

to the survey, or to remove improvements not within the highway as theretofore existing.—Hancock v. Borough of Wyoming, (Pa. Sup.) 24 A. 88.

3. The fact that a strip of land conveyed to a city for highway purposes, while extending from a public street, terminates on private land, and does not connect with any other street or public place, does not take it out of the operation of Pub. St. c. 64, §25, relating to conveyances for highway purposes, since a cul de sac may be a highway. Simmons v. Mumford, 2 R. I. 172, 184, distinguished and doubted.—Greene v. O'Connor, (R. I.) 25 A. 692.

4. Where a town has been laid out, and one of the streets, as originally marked, used by the public for forty-five years, mere nonuser of a portion of such street, occasioned by being fenced in with abutting property, for forty years, will not constitute an abandonment by the public.—Wolfe v. Town of Sullivan, (Ind. Sup.) 32 N. E. 1017.

MUNICIPAL CORPORATIONS.

1. Const. art. 16, § 8, declaring that "municipal and other corporations invested with the privilege of taking property for public use shall make just compensation for property taken or destroyed by the construction or enlargement of their works or improvements," does not give the owner of private property a right of action against a city for injury caused his property by the construction of a sewer inadequate to carry off the water, whereby the water is banked up and backed upon his property, where the construction of the insufficient sewer is due to a mistake of judgment on the part of the city authorities, and not to an improper construction of the sewer.—Bear v. City of Allentown, (Pa. Sup.) 23 A. 1062.

2. Where a city, under legislative authority, constructs, in the bed of a stream, a covered sewer, which in ordinary storms is sufficient to carry off the water, it will not be liable, if by reason of an extraordinary storm, the sewer becomes clogged, and causes the water to overflow,and injure adjoining property. Fair v. City of Philadelphia, 88 Pa. St., 309, and Collins v. City of Philadelphia, 93 Pa. St. 272, followed.—Fairlawn Coal Co. v. City of Scranton, (Pa. Sup.) 23 A. 1069.

3. Where the necessary effect of digging a ditch is to throw water from the public street upon the land of a private person, the municipality that digs the ditch is not relieved of liability for damage done by such water by the fact that the ditch was dug upon the land of a third person with that person's consent.—Wier v. Borough of Plymouth, (Pa. Sup.) 24 A. 94.

4. It is proper to refuse to instruct the jury that, in the absence of clear proof that water running from the street upon

plaintiff's lot was the sole cause of the injury, plaintiffs are not entitled to recover.—Weir v. Borough of Plymouth, (Pa. Sup.) 24 A. 94.

5. Act May 16, 1891, (P. L. 75,) § 8, providing for the appointment of viewers to assess the cost of street improvements in cities "on the property benefitted, according to benefits, if sufficient can be found, but if not," that "the deficiency, when finally ascertained, shall be paid by the municipal corporation," does not deprive the city of the general power to make such improvements at the expense of the city, and the council of a city may set apart, out of the general revenue, sufficient money to pay for the construction of a sewer.—Commonwealth v. George, (Pa. Sup.) 24 A. 59; Id. 61.

6. The committee of the common council of the city of Richmond on streets undertook to change the grade of a street without the authority of the common council. *Held*, that the council had no power to validate the acts of the committee, in the premises, by subsequent ordinance.—Page v. Belvin, (Va.) 14 S. E. 843.

7. The recorded resolution of the committee on streets, their report to the common council, and a resolution of the council founded thereon, referred only to the relaying of gutters in the street in question. *Held*, in an action in trespass for changing the grade, that the testimony of the members of the council was improperly admitted to show that the council in fact ordered the grade of the street to be changed.—Page v. Belvin, (Va.) 14 S. E. 843.

8. Under Const. art. 16, § 8, which declares that municipal corporations "shall make just compensation for property taken, injured, or destroyed by the construction or enlargement of their works, highways, or improvements," plaintiff, who has built a house on his lot in conformity with the existing physical grade of an old public highway in front of the lot, may recover from the city damage to the lot resulting from a change in the grade.—O'Brien v. City of Philadelphia, (Pa. Sup.) 24 A. 1047.

9. Where a city changes the grade of the street, it is not liable to an abutting lot owner for damages resulting therefrom to a house erected on the lot after the change in grade was authorized.—Groff v. City of Philadelphia, Pa. (Sup.) 24 A. 1048.

10. Where a street was laid out on the official plans of the city when plaintiff purchased an abutting lot, and was thereafter dedicated for highway purposes by a proper deed, and subsequently thereto was opened and graded by the city, the city is liable to plaintiff for any damages occasioned thereby. —Hobson v. City of Philadelphia, (Pa. Sup.) 24 A. 1048.

11. Rev. St. 1891, c. 24, art. 9, § 1, authorizes cities and villages to make "local improvements by special assessment, or by special taxation, or both, of contiguous property, or by general taxation, or otherwise, as they shall by ordinance prescribe." Section 2 requires the ordinance providing for such an improvement to "prescribe whether the same shall be made by special assessment, or by special taxation of contiguous property, or general taxation, or both. *Held*, that a city could not combine general taxation, special taxation, and special assessment in making a single improvement.—Kuehner v. City of Freeport, (Ill. Sup.) 32 N. E. 372.

12. Laws 1867, c. 479, (Dunkirk Village Charter,) tit. 12, provided that the village trustees should publish a resolution of its intention to construct a sewer, and give an opportunity for the hearing of objections before ordering the sewer to be built. Title 13 authorized the trustees to order the paving or grading of a street, and caused the expense to be assessed, but required no adoption or publication of intention to pave or grade the street. Laws 1880, c, 19, changed the village into a city, and amended the charter of 1867. Title 12 of the charter as amended consolidated the provisions for constructing sewers with those for grading and paving streets, and provides that, whenever the common council of the city may deem it necessary to construct a sewer or to grade or pave a street, it may declare by resolution its intention to do so, and order the work to be done; but it does not provide for publishing the resolution or for hearing objections. *Held*, that the provisions of the village charter of 1867 as to publication and opportunity to object, if in force at all under the repealing clause of the city charter of 1880, is only in respect to constructing sewers, and does not apply to paving streets.—Lake Shore & M. S. R. Co. v. City of Dunkirk, (Sup.) 20 N. Y. S. 596; New York, L. E. & W. R. Co. v. Same, Id.

13. The charter of Duluth provides that the board of public works shall, subject to the approval of the common council, establish a system of grades for all streets, avenues, and alleys within the corporate limits for which grades have not been heretofore established, and that, to change a grade once established, there must be a resolution of the council, passed by a vote of two-thirds of the members-elect. *Held*, that it was the intention of the legislature to require the permanent grade to be established before any proceedings for the permanent improvement of a street at the expense of the real property should be commenced.—State v. Judges of District Court of Eleventh Judicial District, (Minn.) 53 N. W. 800.

14. An agreement was made by a city with a railway company not to oppose before the railroad commissioners certain

changes which the company desired to make on its line through the city, by which it would partly cut off travel on several streets, the consideration being that the company would pay the property owners on such streets whatever damage their property suffered. The contract was entered into at the request of the owners of the property for their benefit and protection. *Held*, that the contract was against public policy, and void, since it was made by public officials in consideration of private benefit to certain individuals, and no provision was made by which the public was recompensed for its loss of the right of travel through the street.—City of New Haven v. New Haven & D. R. Co., (Conn.) 25 A. 316.

15. A village, being responsible for injuries caused by defects in its streets, and being charged by law with the duty of keeping them in repair, may maintain an action to prevent them from being torn up or excavated.—Waukesha Hygeia Mineral Spring Co. v. Village of Waukesha (Wis.) 53 N. W. 675.

16. Under a village charter giving control over the public streets, and power to pass any ordinance "usual or necessary for the well-being of the inhabitants," the village may limit the time trains may block a street crossing.—Burger v. Missouri Pac. R. Co., (Mo. Sup.) 20 S. W. 439.

17. The location of a sewer in a city street must be reasonable, with respect to the rights of a street railway, the construction of which was authorized by a prior ordinance, and whose property might be damaged by such sewer; and such location, if made in a part of the street occupied by the railway, so as to compel it to suspend operations, and inflict great damage upon it, is unreasonable, when other parts of the street are equally suitable for the sewer.—Clapp v. City of Spokane, (C. C.) 53 F. 515.

RAILROADS.

1. In an action to recover damages for an overflow, caused, as alleged, by the construction of an embankment across one branch of a water course, an instruction that no recovery can be had if the jury "find from the evidence that the damage complained of was due to an overflow, caused by an extraordinary rainfall or flood," is misleading and properly refused. —Ohio & M. Ry. Co. v. Webb, (Ill. Sup.) 32 N. E. 527.

2. In an action against a railroad company for damages resulting from the construction of a solid embankment so as to obstruct the natural flow of a stream, an instruction that "it is the duty of a railroad company to construct and maintain its road across streams and natural water courses which it intersects so as to inflict no injury upon adjacent lands," is not too

broad, as stating it to be the duty of the railroad company to inflict no injury whatever, when it is made plain by other instructions, and the allegations and proofs in the case, that it was sought to hold the defendent liable only for injury which might have been avoided by the proper construction of an embankment with culverts.—Ohio & M. Ry. Co. v. Thillman, (Ill. Sup.) 32 N. E. 529.

3. In an action against a railroad company for damages resulting from the construction of a solid embankment so as to obstruct the natural flow of a stream, it is not error to instruct the jury that it is the duty of a railroad company to construct and maintain its road across streams so as to inflict no injury on adjacent lands, and that "this duty is a continuing one, and each overflow caused by the negligence or want of skill of the company creates a new cause for damages to the crops or other property of the rightful possessor of the lands overflowed."—Ohio & M. Ry. Co. v. Thillman, (Ill. Sup.) 32 N. E. 529.

4. Where, in the construction of a railroad, a stream is turned from its natural course, and made to pass under the track in the channel of another stream, merely for the purpose of diminishing expense, the company will be liable in damages for overflow caused thereby above the point of original intersection of the streams, as well below as above the track, though the water-way under the track furnished ample room for the passage of the water in time of freshet.—Adams v. Durham & N. R. Co., (N. C.) 14 S. E. 857.

5. Where a railway company builds its road through a fenced pasture, and fails to erect and maintain cattle guards at the entrance and exit of its road to and from the pasture, as required by statute, the owner may recover damages for the loss of the pasture, or, if he put his animals therein, to reasonable compensation for his efforts in preventing them from straying from the pasture, and injuring the crops on his own premises, or from trespassing on the lands of other persons. Railway Co. v. Behney, 28 P. 980, 48 Kan.—followed.—Nelson v. St. Louis & S. F. Ry. Co., (Kan.) 30 P. 178.

RIPARIAN RIGHTS.

1. Where the mainland on both sides of a stream and an island dividing the stream have been surveyed and sold by the government as separate parcels, the *filum aquae* is established in the center of the channels on both sides of the Island, between it and the mainland, as though two distinct streams existed; and where the owner of the island also owns the mainland on one side of the stream, for hydraulic purposes he is entitled to the use of the entire natural flow of water in the

channel on the side of the island on which he owns the mainland, and one-half of the flow on the opposite channel.—West v. Fox River Paper Co., (Wis.) 52 N. W. 803.

2. The title to land over which the tide ebbs and flows is in the state, and a conveyance thereof vests the absolute title in the grantee.—Bowlby v. Shively, (Or.) 30 P. 154; Hogg v. Davis, Id. 160.

3. Where a meandered lake is "non-navigable," in fact, the patentee of the riparian land takes the fee to the center of the lake; but, if the lake is "navigable" in fact, its waters and bed belong to the state in its sovereign capacity, and the riparian patentee takes the fee only to the water line, but with all the rights incident to riparian ownership on navigable waters, including the right to accretions or relictions formed in front of his land by the action or recession of the water.—Lamprey v. Metcalf, (Minn.) 53 N. W. 1139.

4. When the United States has disposed of the lands bordering on a meandered lake, by patent, without reservation or restriction, it has nothing left to convey, and any patent thereafter issued for land forming the bed, or former bed of the lake, is void and inoperative.—Lamprey v. Metcalf, (Minn.) 53 N. W. 1139.

5. Where the United States has made grants without reservation or restriction of public lands bounded on streams or other waters, the question whether the lands forming the beds of the waters belong to the state, or to the owners of the riparian lands, is to be determined entirely by the law of the state in which the lands lie.—Lamprey v. Metcalf, (Minn.) 53 N. W. 1139.

6. The owner of a city lot bounded on one side by a street which is located along a river, is not entitled, as a riparian proprietor, to land formed by accretions on the opposite side of the street.—Lebeaume v. Poctlington, 21 Mo. 36, and Smith v. Public Schools, 30 Mo. 294 followed.—Ellinger v. Missouri Pac. Ry. Co., (Mo. Sup.) 20 S. W. 800.

7. A vender who sells the entire estate owned by him up to the line of a public road bordering a river, and beyond which no property susceptible of private ownership exists at date of sale, retains no estate to which the accessory right to future alluvion can attach; and since the purchaser must bear the loss in case of any encroachment by the river, he is entitled to the alluvion on the equitable principle that "qui sentit onus, sentire debet et commodum."—Succession of Delachaise v. Maginnis, (La.) 11 So. 715.

8. The intervention of a public road between an estate and the river, does not prevent the owner of the estate from being considered as the front or riparian proprietor, when

nothing susceptible of private ownership exists between the road and the river.—Succession of Delachaise v. Maginnis,(La.) 11 So. 715.

9. Where the owner of "Rice's Point," on Duluth bay, platted it into blocks and streets, some of the blocks being entirely out in the water, beyond, and in front of the shore block, he indicated his intention to separate the shore block from the submerged blocks, and a deed of the former, according to the plat, conveys no interest in the latter.—Gilbert v. Eldrige, 59, N. W. 679, 47 Minn. 210, followed.—Bradshaw v. Duluth Imperial Mill Co., (Minn.) 53 N. W. 1066.

10. The right of the riparian proprietor on navigable waters to reclaim and occupy the submerged lands out to the point of navigability may be separated from the shore land, and transferred to one having no interest in the parent riparian estate.—Bradshaw v. Duluth Imperial Mill Co., (Minn.) 53 N. W. 1066.

11. The fee in the streets, alleys, commons, and public grounds, as exhibited on the maps of the subdivision of fractional sections ten and fifteen, lying on the lake front of Chicago, is vested in the city, together with the riparian rights appertaining thereto; and these rights were not divested by the fact that the Illinois Central Railroad occupied the lands underlying the immediate front, and filled them in for its right of way, under authority of a city ordinance; and the city still has the right to exercise such riparian rights, subject to the terms of the ordinance and to the authority of the state to prescribe the lines beyond which no structures may be extended, and also subject to such supervision and control as the United States may lawfully exercise. 33 F. 730 affirmed.—Illinois Cent. R. Co. v. State, 13 S. Ct. 110; City of Chicago v. Illinois Cent. R. Co., Id.; State v. Illinois Cent. R. Co., Id.

12. An island in a lake, proved to have existed as such prior to the survey of 1851, though not then platted, and by process of accretion since become joined by a spit to a neighboring lot, is not a portion of that lot.—Bigelow v. Hoover, (Iowa,) 52 N. W. 124.

13. Alluvion deposited against an island in a lake and a neighboring lot, so as to connect them, must be equally divided between the owners of both.—Bigelow v. Hoover, (Iowa,) 52 N. W. 124.

14. Long Pond, in Concord, whose bed, in its natural condition contains about 160 acres, being navigable within the meaning of the American common law, is the property of the state for the use of the public.—Concord Manuf'g Co. v. Robertson, (N. H.) 25 A. 718.

15. Where the owner of land abutting on Lake Superior

plats it, together with the shallows beyond the shore, the establishment of a dock line inside of some of the submerged blocks, does not divest any property rights therein, but merely regulates and limits their use; so that while the dock line remains in force, the owner cannot use the property for any purpose inconsistent with the public right of navigation; but the change of location of dock line to a point outside of the lots removes this limitation, and amounts to authority from the state to fill in and build out to the new line—Bradshaw v. Duluth Imperial Mill Co., (Minn.) 53 N. W. 1066.

16. The reclamation of the Illinois Central Railroad Co. from the waters of Lake Michigan of a tract 200 feet wide, extending along the front of the city of Chicago, and the construction of its tracks, crossings, guards, etc., and the erection of the breakwater on the east thereof, and the necessary works for the protection of the shore on the west, all as required by the ordinance under which it was permitted to enter the city, did not interfere with any useful freedom in the use of the waters of the lake, for commerce—foreign, interstate, or domestic,—or constitute such an encroachment upon the domain of the state as to require the interposition of a court for their removal, or for any restraint in their use. 33 F. 730 affirmed.—Illinois Cent. R. Co. v. State, 13 S. Ct. 110; City of Chicago v. Illinois Cent. R. Co., Id.; State v. Illinois Cent. R. Co., Id.

17. The railroad company did not, however, acquire by such reclamation, an absolute fee in the lands reclaimed, or any right of use, disposal or control, except for a right of way, and for railroad purposes; nor did it thereby acquire any rights as a riparian owner, to reclaim still further lands from the lake for its use, or for the construction of piers, docks and wharves, in furtherance of its business.—Illinois Cent. R. Co. v. State. 13 S. Ct. 110; City of Chicago v. Illinois Cent. R. Co., Id.; State v. Illinois Cent. R. Co., Id.

18. In respect to the lots lying north of Randolph street, in said city, and the lots in front of Michigan avenue, all bordering on the lake, and to which the company acquired the fee by purchase, it was vested with riparian rights, and thereby became entitled to fill up the shallow waters of the lake, and to construct piers, wharves, docks and slips not extending beyond the point of navigability. 33 F. 730, affirmed.—Illinois Cent. R. Co. v. State, 13 S. Ct. 110; City of Chicago v. Illinois Cent. R. Co., Id.; State v. Illinois Cent. R. Co., Id.

19. The Hudson River Railroad cannot, by virtue merely of the construction of its railroad under charter along the east side of the Hudson river, on land partly below high water, conveyed to it for that purpose by owners of the adjacent uplands, be regarded as an adjacent owner, within Laws 1850, c. 283,

allowing a grant of land under water only to such an owner; and neither can it be allowed to defeat a grant to a private person under said charter of land next under the water to its own, and which does not interfere with its operation, by extending its tracks thereover pending application for the grant under supposed authority conferred by charter to alter its location at any time; and particularly can this not be allowed, as the mere enlargement of its location as proposed is not an alteration within meaning of the charter. 16 N. Y. S. 674, affirmed.—New York Cent. & H. R. R. Co. v. Aldridge, (N. Y. App.) 32 N. E. 50; Saunders v. New York Cent. & H. R. R. Co., Id. 54.

20. The conveyance of land for a railroad right of way, partly above and partly below high water, along the bank of a river, by one owning the adjacent uplands, does not destroy the grantor's character as riparian owner, so that a patent may not issue to him under Laws 1850, c. 283, as to the owner of adjacent land, for the land lying next under the water.—New York Cent. & H. R. R. Co. v. Aldridge, (N. Y. App.) 32 N. E. 50; Saunders v. New York Cent. and H. R. R. Co., Id. 54.

21. Where one, without right, enters on, and fills up land under navigable water, thereby raising it above the water, he acquires no title to such land, and is not an adjacent owner, within the statute—People v. Commissioners of Land Office, (N. Y. App.) 32 N. E. 139.

BUSINESS TRANSACTIONS.

The business meeting of the convention was held on Thursday morning, January 19.

The report of the Secretary was read as follows:

SECRETARY'S REPORT.

Since the reports published in our last Annual the following business has been transacted for the Society:

The annual meeting of the board of directors was held at the Hudson House in Lansing, October 12, 1892. There were present Secretary Hodgman, Director Steele, and members Appleton, Skeels and Sellers.

The members of the board present assumed the right to canvass the votes for officers, and the following were declared elected for the ensuing year: President, E. W. Muenscher; Vice-President, Geo. S. Pierson; Secretary-Treasurer, F. Hodgman; Directors, Wm. Appleton, Dorr Skeels and J. B. Davis.

Messrs. Appleton and Skeels filed their acceptance of the offices to which they had been elected.

The annual report of the Secretary was read and approved.

The annual report of the Treasurer was read and approved.

The memberships of the following persons were declared annulled, for two years' non-payment of dues, as provided by by-law No. 6, viz: James Wiseman, O. S. Heyden, J. Kvam, T. W. Pettee, H. L. Chapin, A. Childs, E. C. Martin, and Willis Baldwin. Communications were read from other delinquent members and action in their cases deferred.

It was voted to hold the next annual meeting in Lansing, in the third week in January, 1893. The Secretary was directed to invite certain members of the Society to prepare papers for the convention, and it was determined to make the road question the leading topic of discussion and to set apart the second day of the convention for that purpose.

The further arrangements for the convention were left to the President, Secretary, and members living in Lansing.

The bill of Geo. E. Steele for $14.85 for expenses attending the meeting of the board of directors, was audited and allowed.

The board then adjourned.

The following are the reports submitted to the board of directors:

SECRETARY'S REPORT TO DIRECTORS.

GENTLEMEN: I would report the following business transacted by me for the Society since the annual convention at Grand Rapids:

Immediately after the convention the job of printing the Annual was let to the lowest bidders, R. Smith & Co., of Lansing, and the copy prepared for them as fast as possible. There was some delay in getting advertisements, but the Annual was out before July 1, and distributed to all of our members not in arrears for dues. Exchange copies were sent to our sister societies in Ohio, Indiana, Illinois, Iowa, to the Provincial Land Surveyors in Canada, and to the engineering societies of the universities at Ann Arbor and Champaign. Return copies of reports have recently been received from all these societies except Ohio and the Provincial Land Surveyors. The Dominion Land Surveyors do not publish any reports this year.

I had 1,500 copies of our Annual published, and we now have on hand enough copies for several other exchanges if they could be secured.

On the first Monday in March I sent out letter ballots for officers and new members to all our members who were entitled to vote, and statements of account to all who were in arrears. I regret to say that but a small per cent. of the members have cast their ballots. On the first Monday in April the ballots for members were opened and canvassed by me and all the applicants found to be elected. On the first day of July I again sent statements to all who were in arrears for dues. On the first Monday in March I mailed to every member who was two years or more in arrears for dues a copy of the by-law No. 6, and the notice required by the by-law. The following members to whom such notices were mailed to their last known address, are still in arrears: J. J. Watkins, James Wiseman, O.

S. Heyden, J. Kvam, T. W. Pettee, H. C. Thompson, H. L. Chapin, E. F. Guild, G. A. Mark, C. B. Hyde, A. Childs, I. Teller, R. B. Merritt (deceased), E. C. Martin, and Willis Baldwin. I hand you herewith letters from some of these parties bearing on the subject. I have received notices of the deaths of John M. Clark and John O. Palmer, and saw an item in a Detroit paper referring to the death of R. B. Merritt, but have not been notified of it by his family.

F. HODGMAN,
Secretary.

TREASURER'S REPORT.

I would respectfully report the following sums as having been received and disbursed by me during the year ending October 12, 1892.

RECEIPTS.

On hand Oct. 14, 1891	$148 01	
Received from annual dues	253 00	
Received from advertisers	260 60	
Received membership fees	47 00	
Received from reports sold	17 50	
Total		$726 11

EXPENDITURES.

Expenses of Board of Directors	$ 11 25	
Express, freight, and drayage	29 07	
Miscellaneous printing	12 83	
Postage and envelopes	56 34	
Cuts and inset for Annuals	58 26	
Printing Annuals	261 37	
Collection fees	1 75	
American Digest	10 00	
Copyright	1 00	
Stenographer	54 00	
Telegraphing	1 12	
Secretary's salary, 1891	100 00	
Balance on hand Oct. 12, 1892	129 12	
Total		$726 11

The society owes nobody a cent.

There is due it from 19 members one year's dues each	$ 38 00
There is due it from 4 members two years dues each..	16 00
There is due it from 6 members three years dues each.	36 00
There is due it from 4 members four years dues each..	32 00
There is due it from advertisers.....	51 00
	$173 00

F. HODGMAN, Treasurer.

Subscribed and sworn to before me this 12th day of October, 1892.

GEORGE E. STEELE,
Notary Public.

The foregoing reports were accepted by the convention.

The following persons were nominated for officers for the next year: For President, E. W. Muenscher; for Vice-President, Geo. S. Pierson; for Secretary-Treasurer, F. Hodgman; for Directors, J. J. Granville, Dorr Skeels, J. B. Davis, James L. Rumsey, A. J. Teed, John McLoughlin and Ernest Sellers.

The reports of the Committee on State Boundary was read and adopted, and the committee directed to prepare and present a memorial to the Legislature. For report and memorial see page 77.

The report of the Committee on Road Legislation was received, discussed, amended and adopted. For report and memorial, see page 181.

Mr. Rogers extended an invitation for the next convention to be held in Port Huron. Mr. Granville gave a similar invitation for Saginaw, Mr. Teed for Cadillac and Mr. Skeels for Grand Rapids.

The Secretary called attention to the fact, that during the past year he had sent out statements three times at intervals of three months to every member in arrears for dues, and after that had drawn through the bank on those still in arrears. Some had paid when drawn on, some paid no attention to statements or draft, and one member considered it an outrage to be drawn on and had withdrawn from the society in consequence. He desired an expression from the society as to the propriety of drawing on members for their dues.

It was voted that the Secretary be directed to draw on

members for their dues when they do not respond otherwise.

It was voted to reprint 500 copies of the first two reports of the society at an expense not to exceed $60.00.

A committee consisting of Geo. L. Wells, Geo. M. Ames, John J. Granville, Henry F. Bean, and John McLoughlin was appointed to solicit advertisements for the Annual.

NOTE.—The Secretary here desires to acknowledge the assistance he has received from Charles Holmes, F. F. Rogers, D. J. Albertson and H. G. Rothwell in procuring advertising for the Annual. It has been of the greatest value and we should have been closely pinched to meet the extra expenses of 1893 without it.

A committee consisting of J. J. Granville, Wm. B. Sears and Seth Dean was appointed to prepare specifications for common roads, and it was voted that the Secretary send out advance copies of the same, previous to the next convention for the consideration and criticism of the members.

The following discussion was had relative to the preparation of papers for our annual convention.

THE PRESIDENT: I think it would be well to have a circular printed and send it around to city engineers and all others whose address can be obtained, soliciting them personally. And if any member of the Society has any subject in which he is interested, to have it suggested, so that others could be requested to write papers on that subject. Now for myself, I find very interesting this street railroad system, which is being very rapidly extended throughout the state. All our citizens are interested in it, and some of our roads are beginning to adopt a form of rail which I think is going to be very dangerous. I should like to have some one familiar with that subject, take it up in a paper—the form of street rails. I am inclined to think that the "T" rail now introduced is very dangerous, and that every city that introduces it, will rue the day. I may be mistaken, but would like to learn the experience of different cities on that point. I requested Mr. McLoughlin to write a paper on that subject, but he was unable to do so. Another thing that would interest me would be a paper on the different kinds of motive power used by street railways. I refer to the cable, electricity, and any other motive power in use. I know that some of our members are as competent as any men in the world, and they could furnish

such a paper as that if they would. I think there are very few of us that could listen to such a paper without learning something; I doubt if there are five members that could explain the operation of the trolley system.

Mr. Appleton: I know there is a man here who if he could be induced to do it, could tell us a great deal about it.

The President: I should like such a member to gather what he can on this subject, and when we meet again, tell us what the progress has been in electric motors during the past year; it is something that is going to be fresh every year, and yet we come here and neglect these fresh, interesting subjects entirely.

Mr. Hodgman: One of the great difficulties with which the officers of this Society have had to contend in preparing for the convention, was in getting some one to suggest topics, and in getting suitable persons to discuss them. I have sometimes been afraid we should fail entirely on account of the lack of responses. So many have their hands full, and yet some of our best contributors are our hardest worked men. Prof. Davis said, "Don't you know, Hodgman, that if you want to call on some one to do a thing, you must call on some one who has his hands full already." A good many of our very ablest members have never lifted their hands to do anything.

Mr. Granville: The trouble is, a good many of the new members are young men, and are too modest.

Mr. Hodgman: I have urged our young members to prepare things because it is for their own benefit. Nothing will help a young man so much as to take a subject, study it up and write a paper on it. Even if the paper he produces doesn't go to the bottom of the thing at all, it may bring on a discussion and bring out some very valuable thoughts.

Mr. Appleton: In looking over the Society this year, I think while there have been many excellent papers, on a great many subjects, there is a remarkable absence of mechanical engineering. Prof. Cooley has not been here,—Durand has gone from the College, and we seem to have no real live worker in that particular branch. I think this Annual will be very barren. Nothing in the field of electricity—no new

machinery—nothing of that kind ready to go into this Annual, and while we have some excellent things, there is an absence of some other things of a good deal of interest. Mechanical engineering is in its infancy, and is growing more and more interesting.

MR. RANDALL: I would like to second Mr. Appleton's remarks. I think no engineer can do his duty without knowing something of mechanical engineering. Our work is so closely connected with mechanical engineering that it will not hurt us to get some of these treatises on different branches of mechanical engineering.

THE PRESIDENT: I should like very much at our next meeting to have some of our members who are particularly interested in hydraulic engineering give us the results of recent progress in the construction of pumping engines. There has been a wonderful advance in pumping machinery in the last few years.

MR. BEAN: And how few are aware where the latest improvements are.

THE PRESIDENT: I shouldn't be surprised if the Society would be very glad to have Mr. Pierson give us something on this subject.

MR. APPLETON: Very few of you are acquainted with Mr. Jarvis, but he is probably as well posted on the subject of motive power for street railways as any man living, an inventor who has perfected a good many schemes, and I would move it as the sense of this entire meeting, that Mr. Jarvis be requested to prepare for us a paper on the different kinds of motive power used on street railways. I am sure he is capable of giving us a most interesting paper.

Motion supported and carried.

The Secretary was voted $100 for his services during the past year, and a vote of thanks extended to him.

A vote was taken expressing the sympathy of the Society with Mr. Forster in his illness, thanking him for his autobiography, and directing that it be given the place of honor in the forthcoming Annual.

The thanks of the Society were also extended to the President for his earnest work in the convention, to Mr. Sellers for

providing for the local wants of the Society, and to Mayor Bement for the courtesies extended by him.

The convention then adjourned.

MEETING OF BOARD OF DIRECTORS.

A meeting of the board of directors was held during the convention, and applications for membership received and passed upon. Other applications were received by the Secretary and submitted by letter to the board previous to March 1, 1893.

The following persons have been approved for membership by the Board of Directors and elected by letter ballot as members of the Society:

FOR SENIOR MEMBERS.

L. P. Breckenridge, Professor of Mechanical Engineering, Agricultural College, Lansing, Mich.

E. F. Bradt, Mining Engineer and Chemist, Ishpeming, Mich.

B. F. LaRue, Consulting Bridge Engineer, Jackson, Mich.

A. L. Marhoff, City Engineer, Battle Creek, Mich.

E. W. Redman, Civil Engineer, Grand Rapids, Mich.

Ernest Sellers, City Engineer, Lansing, Mich.

M. C. Taft, City Engineer, Kalamazoo, Mich.

William Vincent, Civil Engineer and Surveyor, Manistee, Mich.

T. O. Williams, Civil Engineer and Surveyor, Grand Rapids, Mich.

George F. Bristol, Civil Engineer, Grand Rapids, Mich.

Charles Cummings, Surveyor and Civil Engineer, Marquette, Mich.

FOR JUNIOR MEMBER.

John T. Nellist, Surveyor and Draughtsman, Grand Rapids, Mich.

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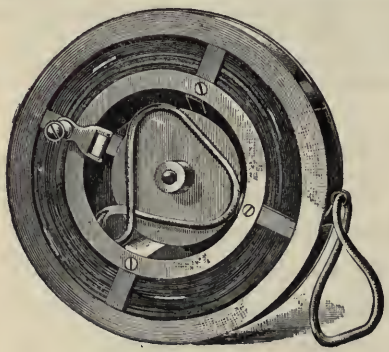

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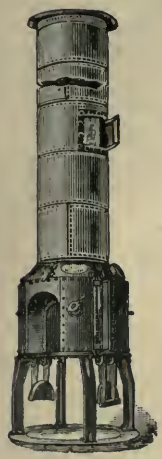

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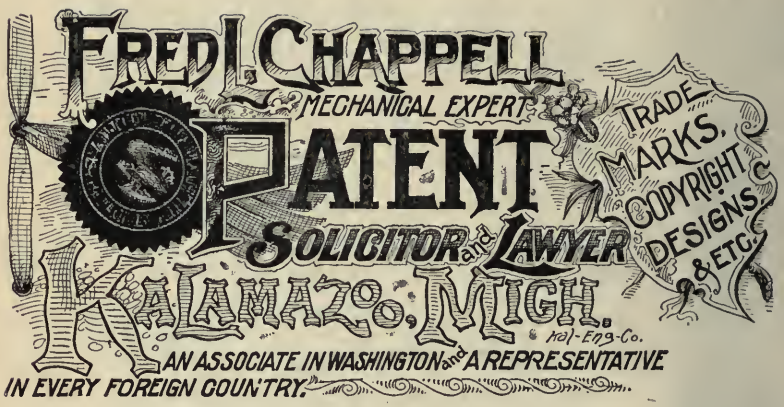

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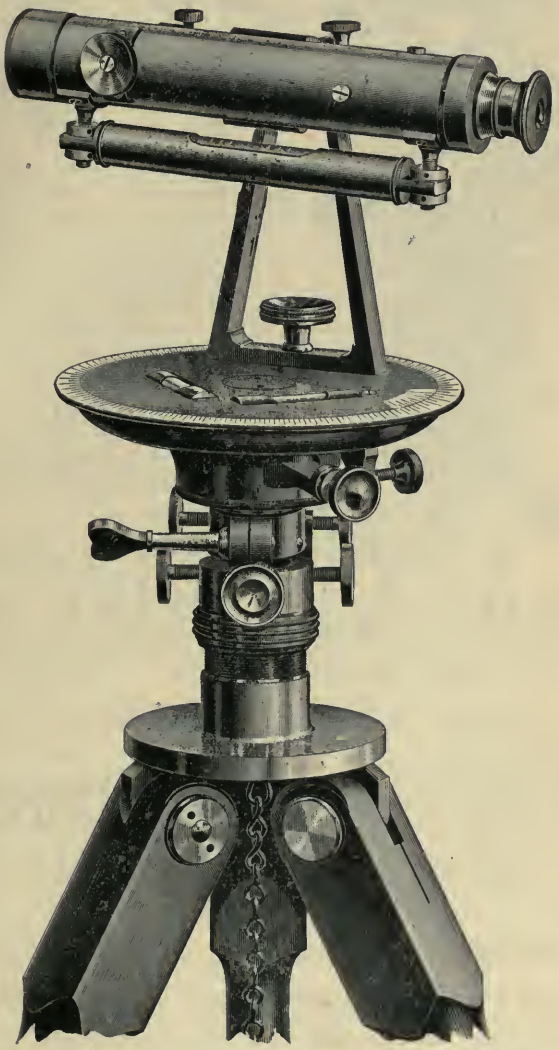

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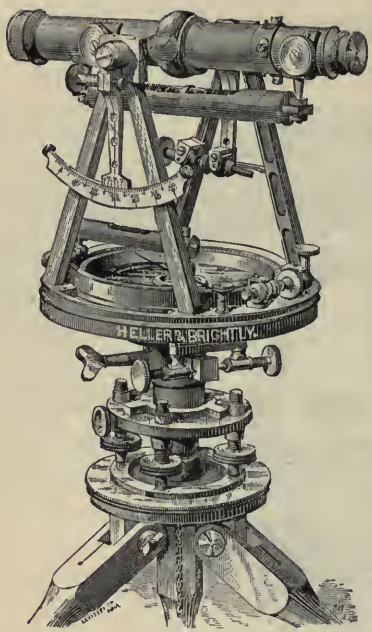

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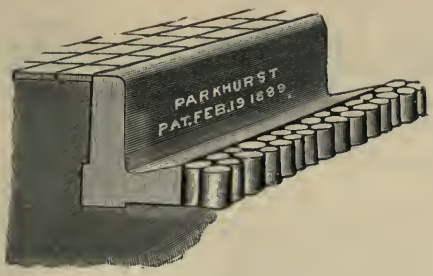

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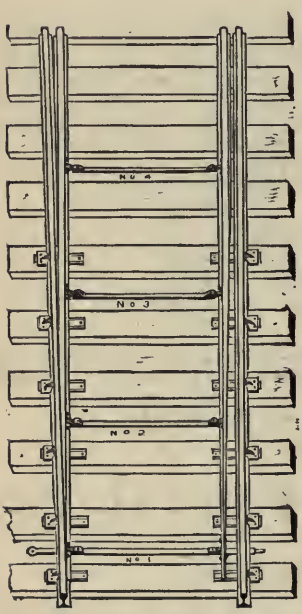

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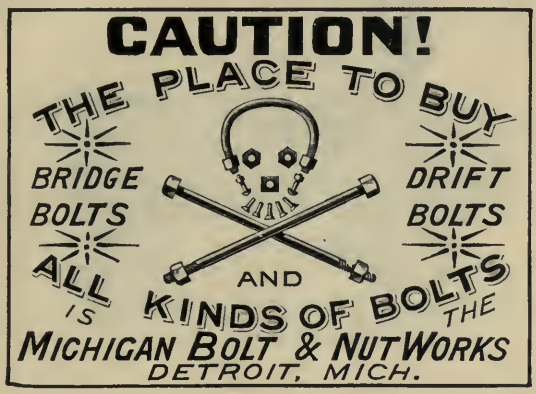

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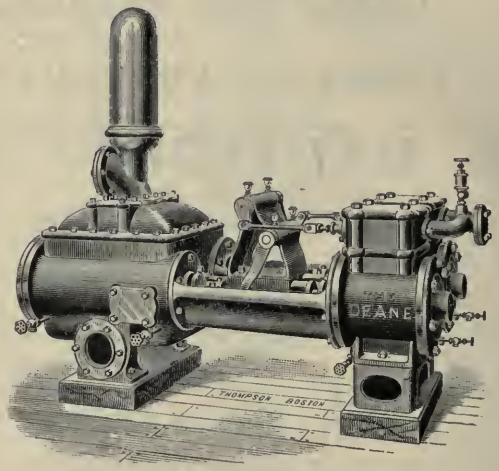

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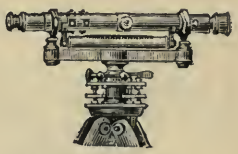

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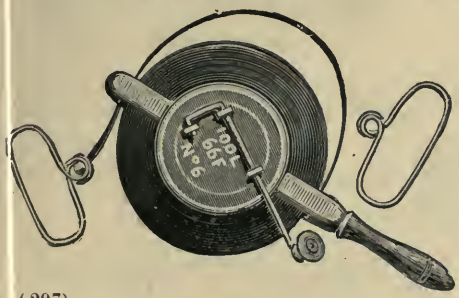

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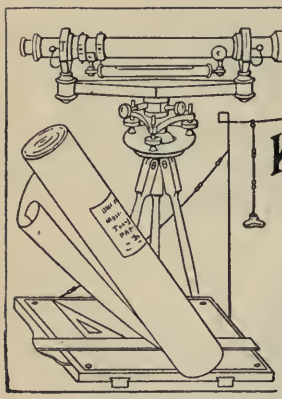

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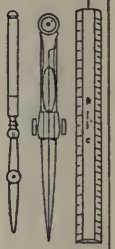

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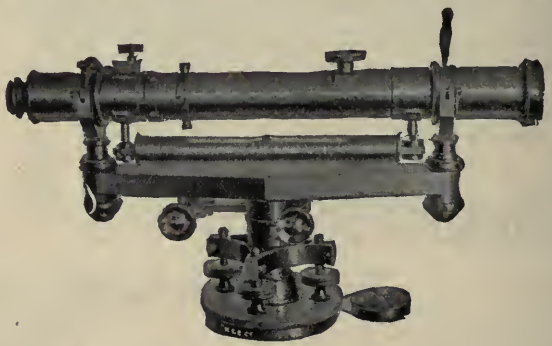

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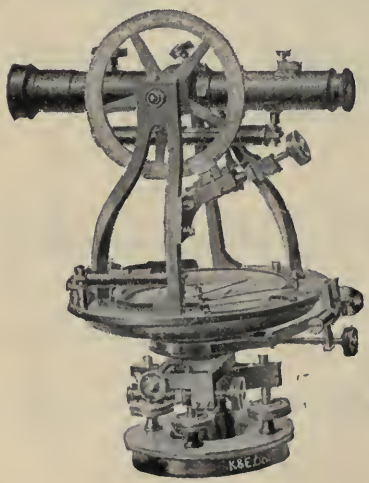

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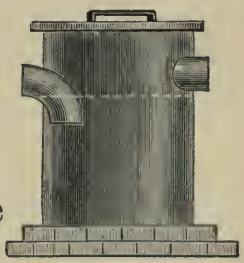

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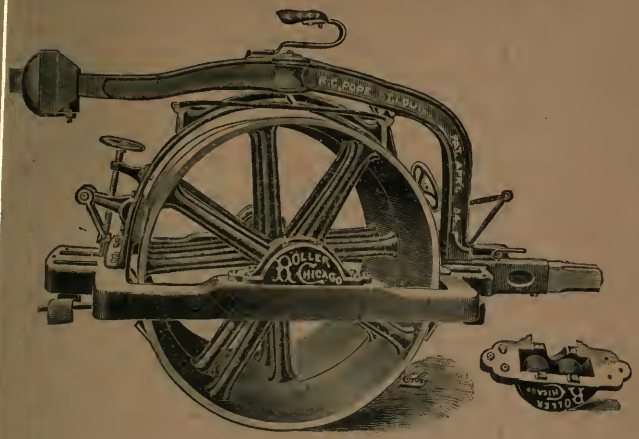

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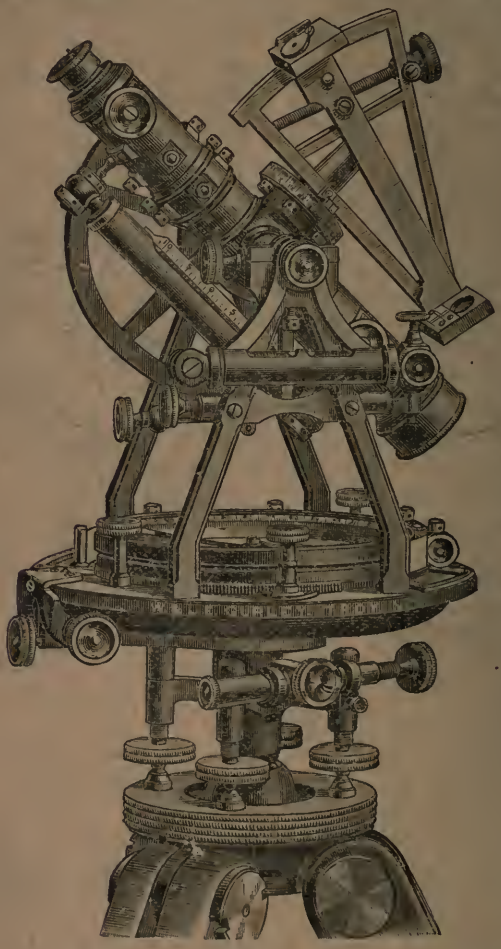

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